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## EDITORIAL.

**The Malabar Coconut Industry.**

Particular interest attaches to the account, given on another page, of the coconut industry on the Malabar coast of India, by reason of the pre-eminent position on the European copra market which was at one time held by the produce from this area. This enviable position was held until the increasing demands of India absorbed the entire production of Malabar.

We would refer the reader to previous articles which have, in recent years, been published by this Department dealing with the coconut industry in Malaya, the Philippines, Ceylon and the Solomon Islands. Comparison shews that the conditions under which coconuts are grown, and the methods of drying the kernel, vary very considerably, but by knowledge of methods and of the conditions obtaining in his own area, the coconut planter is enabled to introduce innovations having as their objects, greater crop production, improved quality of copra and greater economy of production.

In his article on the Malabar coconut industry, the author has given considerable attention to the coir industry.

It is probable that almost every coconut planter in this country has considered, at one time or another, the possibility of utilizing for greater profit the enormous quantities of coconut husks, but, as a rule, he has reluctantly decided that coir production is uneconomic under Malayan conditions. The subject is, however, still a live one, and we have recently seen coir fibre of excellent quality produced on a small plantation in this country and sold locally. The fortunes of this venture will be followed with interest, and it is to be hoped that, although as yet on a small scale, it may result in the establishment of a new Malayan industry.

It is a fact, however, that the bulk of the world's supply of coir is produced as a cottage industry, and under such conditions cost of production is very low. There seems little chance of any large development of coir production as a cottage industry in Malaya, owing to the numerous other and less arduous sources of income open to the small-holder. The local estate-produced coir, therefore, has to compete only with the imported product, and thus has an advantage of lower

freight charges. It is possible that if the quality can be maintained, and the price is attractive, a market may be established in Malaya to replace the net imports which annually exceed 1,000 tons and are valued at over $200,000.

**Palm Oil.**

The attention of readers is drawn to an article by Dr. T. A. Buckley on the "Dietetic Value of Palm Oil". In this article the author emphasises the value of palm oil as compared with that of other vegetable oils, in that it contains carotene, a source of Vitamin A, an important factor in the prevention of disease and promotion of growth.

The only other common oils containing this vitamin are fish oils such as cod liver oil, for which palm oil may be regarded as an efficient substitute, though of inferior quality to halibut liver oil.

Although palm oil, or more accurately, red palm oil is employed for cooking purposes in countries in which the oil palm is indigenous, it is perhaps curious that the local population has not adopted it as a substitute for, or a supplement to the cooking oils they are in the habit of using.

An explanation for this is, that most probably the taste for palm oil has to be acquired. This is unfortunate, since it has been demonstrated that for edible purposes, palm oil has a definite value, particularly as its vitamin activity is not destroyed by heat during cooking processes. We desire particularly to point out that an article on the subject of carotene in palm oil has recently been published by Dr. I. A. Simpson of the Institute of Medical Research, and that the article we reproduce in the present issue of this Journal is, to some extent, a pre-review of Dr. Simpson's paper which has been published earlier than we anticipated.

**Preparation of Derris Roots for Export.**

Much work has been carried out on investigating the insecticidal properties of several species of tropical plants such as *Derris, Lonchocarpus, Cracca* and *Mundulea,* to name only a few. Much, however, still remains to be done before the relative values as insecticides of the different genera, species, and even varieties of these plants can be fully determined on the basis of the actual toxic chemical substances, and of the relative qualities of these substances present in each of them.

Apart from obtaining data regarding the insecticidal efficiencies of such plants, it is highly desirable that growers should be in a position to state the amount and the proportions of toxic substances any particular type of plant grown under certain conditions is likely to yield.

A fairly reliable indication of the toxicity may be secured by testing solutions on various kinds of insects. Seeing, however, that many factors affecting insects used as test subjects must be taken into consideration, and that these factors affect the results of such tests, it is only by prolonged investigation that results are produced on which reliance can be placed with a fair degree of confidence.

The valuation of roots of plants yielding toxins must of necessity be made by chemical means which must conform to accepted standards, if they are to ensure comparable results when employed by other investigators.

This subject has been discussed elsewhere in a publication issued by this Department (Valuation of Tuba Root by C. D. V. Georgi and Gunn Lay Teik, Scientific Series No. 12, 1933). In amplification of this aspect of the subject under discussion, we now print an article in which the same authors describe further experiments designed the show the way to standardization of analytical methods, which, if applied to the analysis of *Derris* root, will enable growers to indicate the toxic composition and minimum toxic content of the root they are desiring to sell.

## Original Articles.

# THE COCONUT INDUSTRY ON THE MALABAR COAST OF INDIA

BY

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The following observations refer only to areas in the coastal districts of Malabar and South Kanara, which, in 1931-32, had a total of 360,932 acres under coconuts, representing nearly two-thirds of the total area under this crop in the Madras Presidency.

Coconuts on the Malabar coast are essentially a small-holder's crop, the average size of a coconut holding or garden being under two acres. Except for one privately-owned estate of 100 acres, there are no organized large-scale plantations. The gardens are so small that the owner and his family can easily attend to the cultivation and harvesting, but some of the owners do not like doing manual work in the field and so employ hired labourers. The majority of the cultivators in the two coconut districts are Malayalees, and Malayalam is the language spoken.

### Soil.

The soil on which coconuts are found growing in the coastal districts varies from almost pure white sand in a narrow band along the coast, through a red sandy loam, to gravelly soils on the hill slopes originating from laterite rock. In none of the localities visited were heavy soils encountered. Drainage is good and is practically all natural. Extensive bunding is carried out on inland areas to prevent soil erosion during the rainy season and also to encourage soil water movement on which the palms rely for their nutriment from the hills to the coast.

### Climate.

The climate on the Malabar coast differs from that in Malaya in that there are definite wet and dry seasons. The average annual rainfall is about 130 inches, of which over three-quarters falls during the South West Monsoon from May to the end of September. This is followed by the North West Monsoon in October and November when from 10 to 15 inches of rain may fall. The remaining five months are practically rainless, small showers being uncertain and inadequate. Growth and nut development are therefore much more seasonal than in Malaya where rainfall is evenly distributed.

### Condition of Holdings.

Planting is usually very irregular and palms of all ages are to be found in one garden. The normal practice is to carry on a programme of under-planting

and to remove old palms as they become unproductive. Despite this, the gardens are well kept but crops are comparatively poor and nut size is small. This is partly due to the fact that, with copra and oil at present prices, the cost of manuring, which is recognized as essential for satisfactory crops on these light soils, is beyond the means of the average peasant. The only form of manuring possible under present conditions is the use of wood ashes and small applications of cowdung and/or green leaf, when obtainable, which are applied in trenches 3 feet wide about 6 feet from the base of the stem just before the monsoon sets in.

### Cultivation.

Cultivation by ploughing is general and is usually carried out at least twice annually. The first ploughing takes place as soon as the rainy season is over and the land is left fallow: no weed growth takes place during the fallow season owing to drought conditions which last until the advent of the next monsoon. The gardens are again ploughed once or twice as soon as the rainy season commences. Surface cultivation is an important factor where rainfall is seasonal as it materially assists conservation of soil moisture during the dry season.

### Planting.

Deep planting is the general practice throughout the coastal area. Three feet cubical pits are dug and a third of the depth filled with top soil, manure and ashes, if available. Seedling nuts, about one year old, are then planted about 2 to 2½ feet below the surface. As the seedling grows so the hole is filled in until ground level is reached. This method is claimed to give a sturdier palm and to encourage deep rooting, a necessary factor during months of drought when the water table is very low. As a result, root development is encouraged from as large a surface of the stem or bole as possible. It is admitted that deep planting delays maturity and palms do not come into bearing as early as those planted on the surface, but the longer life of deep planted palms is claimed to overrule this objection. No development of roots above the surface of the ground was seen and, even on the lightest soils, there was little or no tendency of palms to lean.

### Coconuts on Hill Slopes.

Coconuts are also grown extensively on the foot hills 20 to 25 miles from the coast. The soil here is a red sandy loam overlying a bed of laterite rock at varying depths. The land is terraced and bunded into plots of varying size according to the contour. Here again deep planting is the general rule and manuring is essential to obtain satisfactory crops. The secret of successful cultivation on these hill slopes seems to be the conservation of rainfall in the plots or terraces so that it can penetrate from terrace to terrace without causing soil erosion, and surface cultivation during the dry months. Yields on this type of land are not very high unless extensive manuring is practised. At present prices manuring is not profitable.

### Harvesting.

Harvesting of nuts is carried out at intervals ranging from 1 to 2 months. Dry-season harvests are usually heavy but the crop is poorer during the rainy season. Climbing the palms is the normal method of harvesting and the nuts are removed by hand. There is a noticeable tendency for immature nuts to be harvested, since husks from slightly under-ripe nuts make a better-coloured fibre than those from fully-ripe nuts and this is an important factor in a district where practically every husk is turned into fibre, although it has an effect on the quality of the copra produced.

As reported above, yields are, generally speaking, poor. The average yield for the coastal areas is only 15 to 20 nuts per tree per annum or an average of 1,500 nuts per acre per annum. The average number of nuts per unit weight of copra for the Malabar coast was stated to be 3,500 to 4,500 nuts per ton of copra which is equivalent to 210 to 270 nuts per picul (133⅓ lbs.) of copra and would give a yield of from 6 to 7 piculs of copra per acre.

### Disposal of Crop.

The method of disposal of the crop varies in the different sub-districts. In and around Ponanni, practically the entire crop is sold in the form of nuts to dealers or agents for up-country merchants, who have set up business for this specific purpose. The dealers have middlemen who collect the nuts from villages and other convenient centres and bring them by canal or bullock cart to the wharf. The nuts are then sent to merchants in large towns such as Karachi and Bombay, where they are usually sold as fresh nuts. Sea transport is undertaken in large sailing boats or country craft, which carry up to 7,000 nuts each. Nuts are transported either whole or with the rind, but not the entire husk, removed. The price of nuts at Ponanni at the end of January, 1936, was Rupees thirty-five (Rs. 35) per 1,000 ($22.50 per 1,000). Small nuts are in demand as they are widely used for religious ceremonies in the big towns. There is, therefore, no question of two small nuts counting as one as is found in the Straits but nevertheless the peasant has to give more than 1,000 nuts for the price quoted per 1,000. The excess is supposed to cover losses caused by breakage, and the presence of empty nuts. The producer frequently parts with 1,020 to 1,060 nuts when he is paid for 1,000.

In other districts, such as Badagara, the majority of nuts are made into copra by the small-holder or the nuts are sold to Mohammadan dealers who are professional copra makers. All copra is sun-dried and carefully graded before export. A visit was made to the premises of one big dealer at Badagara. This dealer has extensive copra-drying yards and also owns a small oil mill. Four grades of copra are exported by this dealer to large towns such as Bombay, Madras and Karachi, where it is again handled for export or local consumption. The grades were as follows:—

*1st grade "Boda".*

This is a special grade of copra made from mature nuts which have been stored for 6 to 12 months in the husk. The unhusked nuts are usually stored in a loft, very often over the owner's kitchen quarters. During the dry season no heating or drying is necessary but during the rainy season husk or shell fires are occasionally lit underneath to prevent sufficient moisture collecting to cause germination. After six months the nuts have dried to such an extent that the meat or copra is loose inside the shell. If the nut is then husked, the shell can be cracked and the kernel falls out whole. It is then cut in half and requires but two days' sun-drying before it is ready for export. This perfect copra is sent to Bombay for local consumption and export for use in confectionery and for eating purposes generally. Current prices given by the dealer for this grade of copra were Rs. 85 to Rs. 86 per 640 lbs.

*2nd grade "Madras Nottam".*

This is the highest grade of copra made from mature fresh nuts and is about equal to No. 1 Estate quality copra in Malaya. Nuts are husked, split, and sun-dried for 7 to 8 days. The shell is removed after about the fourth day. The current price for this grade (1st February, 1936) was Rs. 83 per 640 lbs. This is also an edible grade of copra.

*3rd grade "Dhilpasand".*

This is the second grade made from fresh nuts and contains copra from mature and slightly immature nuts, but is nevertheless an edible grade. Current price was Rs. 82 per 640 lbs.

*4th grade "Office Nottam".*

This is the lowest grade exported and contains a good deal of copra from immature nuts. Current price was Rs. 78 per 640 lbs.

Grading is done by hand-picking. All undesirable pieces such as those which are mouldy, leathery, or otherwise unsuitable, are graded out and milled into oil at once in the dealer's own mill.

The only oil mill visited is housed in a very poor building, and consists of a battery of 10 metal *chekku* mills exactly similar in construction to the wooden *chekku* mill used by Indians in Malaya for milling gingelly and copra, but all parts are made of steel, while the pestle and scrapers are stationary and the mortar revolves. Copra can be added and cake removed without stopping the mill. The mill is driven by a main shaft from an oil engine. After sedimentation, the quality of oil appears to be quite satisfactory despite the fact that no filter is provided. A power-driven *chekku* can crush about 12 cwt. of copra in a 24 hour day.

Dealers, and exporters in Calicut, the centre of the Malabar coconut industry, stated that Malabar once produced the best copra in the world but that methods in Ceylon have improved to such an extent that Malabar cannot now compete for export of large quantities of high-grade copra of Ceylon quality.

## The Coir Industry.

The importance of the coir industry can be gauged by the fact that in 1931, about 225,000 persons were engaged in the industry.

As mentioned earlier in the report, hardly a husk is wasted on the Malabar coast. Everywhere one sees signs of the coir industry—either retting pits, bales of coir yarn, bundles of fibre, or baskets of husk.

Coir-making on the Malabar coast is essentially a cottage industry. In none of the places visited were any signs of machinery for coir manufacture observed, except baling presses at some of the exporters' godowns. In practically all cases the various processes are carried out by individual peasants at or near their own houses even if it is piece work carried out for merchants who buy husks and sell the finished yarn.

Practically all the fibre exported is in the form of coir yarn, which consists of a two-ply twist about one-quarter inch diameter suitable for making into matting or into thicker ropes. There are two types of yarn exported, *viz.* soaked and unsoaked yarn. Soaked yarn is that made from husks which have been buried in retting pits for 10 to 12 months. Unsoaked yarn is that made from fresh unretted husks. Practically all unsoaked yarn is produced by the individual small-holder or his dependants whereas, in the case of soaked yarn, the husks are often bought in large quantities by dealers or merchants who arrange for the retting and then give out the work of beating, cleaning and twisting to individuals, usually old women.

The reason why soaked yarn is not generally produced by small-holders from their own husks is that only a few holdings are suitably situated for use as retting pits, which must be near or adjoining a supply of brackish water.

## Retting.

Apart from natural backwaters, only land adjoining tidal rivers or so situated that brackish water can be run in or out at intervals, can be used for retting purposes. For this reason, the production of soaked coir yarn is limited to the few small-holders who have land favourably situated and to dealers or professional coir manufacturers who can afford to rent land accessible to brackish water.

Pits are dug 6 feet deep or of sufficient depth to hold water 3 feet deep throughout the year, *i.e.* 3 feet below mean water table. The soil is usually very sandy so that free soil water movement is always taking place. This gradual movement of brackish water in and out of the pits is considered essential to the production of good colour in the fibre. Stagnant water spoils the colour of the fibre, owing, perhaps, to the concentration of the products of fermentation.

Fresh green husks, from slightly under-ripe nuts, are placed in the pits up to about 12 inches below water level, and are covered with a layer of plaited palm leaves and weighted with soil or stones to keep them from floating. It is important that fresh green husks should not be exposed to the sun too long before retting.

A Retting Pit at Ponanni. Retted husks being washed and removed from the pit.

Bales of Coir Yarn ready for shipment from the Holding to Dealers in large Towns.

Husks are left in the pits for 10 months or longer. A strong smell of hydrogen sulphide is usually apparent near the pits due to decomposition which goes on in the husk. The necessity for using husks from slightly under-ripe nuts and the fact that immature nuts will not keep for long once they have been husked has had a marked effect on the quality of the copra from coir-making districts.

### Skinning and Beating.

The husks, having been removed from the pit, are handed over to women who remove the outer skin or rind and beat out the fibre by a simple but rather strenuous process, using a small round stick of hard wood or a mallet to beat the husk on a block of similar wood. The pithy matter is very quickly removed and the pure fibre remains. One woman can beat the fibre from the husks of about 100 nuts per day.

After beating, the fibre is sun-dried and either stored or immediately twisted into yarn. Properly retted fibre should not lose its golden colour on exposure during drying.

### Twisting or Spinning.

This is a process requiring some skill and experience as it is nearly all done by hand. The usual method is to twist the yarn by rubbing the hands together with a circular motion taking a twist of fibre from a heap placed on either side of the spinner. The twisted yarn, consisting of a two-ply yarn about $\frac{1}{4}$ inch in diameter is extremely regular in thickness considering the way in which it is made. There is also a hand-machine for twisting yarn called a *charka,* but the writer had no opportunity of seeing one of these working. The unit of twisted yarn is a hank of approximately 132 feet. Hanks of yarn are made up into bales of 70 hanks (about 2 feet in length) weighing about 80 lbs. These bales are sold to dealers or exporters.

### Unsoaked Yarn.

Unsoaked yarn is made from fresh unretted husks, and is usually made by the peasant who has no access to land suitable for retting pits. It is made in exactly the same way as soaked yarn except that the husk is severely pounded with a heavy pole or iron pestle before the outer skin or rind can be removed. Beating is much harder work and takes longer. The resulting fibre contains a considerable amount of pith and waste which would have become easily detached from retted husks. The yarn is also much softer but not so strong and is not usually a good colour. The difference in price between this and soaked yarn is only about 1 to 2 shillings per cwt. in favour of the latter.

### Grading and Baling.

There are a number of European firms on the coast who deal in the yarn and grade it for export—grading is rarely done by the producer. The stores of two such firms were visited during the tour. The bales of yarn, brought in by

dealers, are weighed and approximately 50 per cent. of the estimated value paid in cash. The bales are opened up and the hanks laid out on barbecues for drying; the yarn often contains as much as 25 per cent. moisture, particularly in the case of unsoaked yarn. After drying and grading is completed, the dealer's account is settled on the actual value of yarn brought in.

The two types of yarn are graded according to quality. The various grades are named after the localities from which the particular grade originated. Quality or grade is decided on factors such as colour and twist. After drying and grading the hanks are joined together by girls and women—another skilled piece of workmanship; it is almost impossible to discern where joins have been made—and "carded" or wound into more bulky hanks on a revolving frame. Each of these hanks contains from 250 to 300 yards of unbroken yarn.

The yarn is aired and then baled in presses to reduce volume to a minimum without causing breakage of the yarn. Each bale for export weights 336 lbs.

Current prices on the London market at the time of the visit were from 16 to 18 shillings per cwt. for soaked yarn and 15 shillings per cwt. for unsoaked yarn.

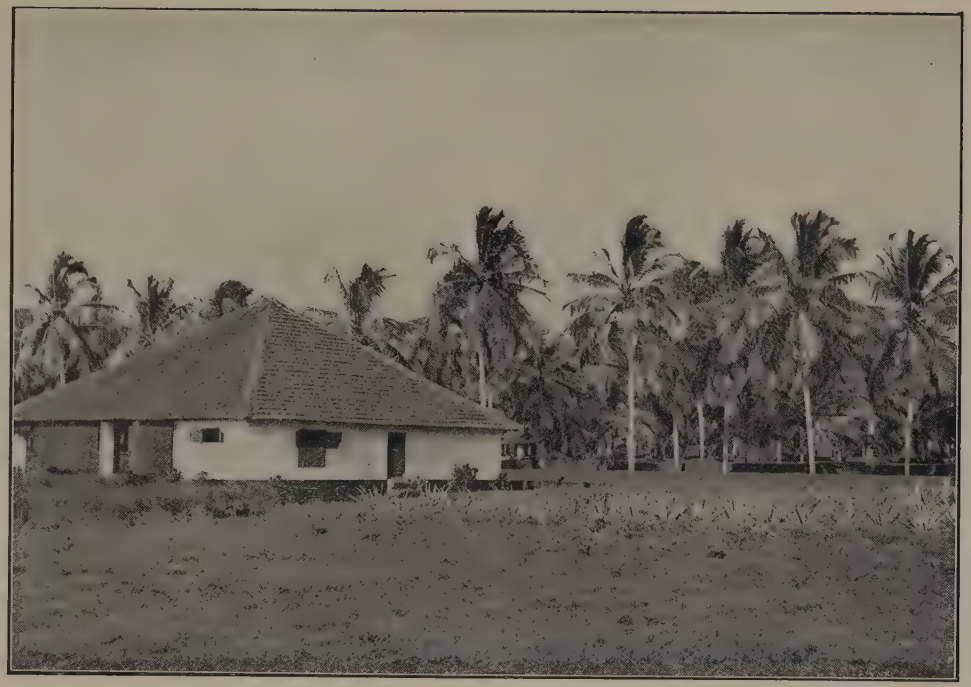
### Costs and Labour.

In the case of soaked fibre, a dealer or merchant will often buy fresh husks and rent a suitable piece of land for retting pits. Fresh husks may be bought from the small-holders at Rs. 6 per 1,000 nut husks. Rent of sufficient land to soak 100,000 husks will be about Rs. 8 per annum. After 10 months' retting, the dealer may sell the husks in the pits to another dealer, who is also a professional coir maker, at Rs. 8 per 1,000 which allows a small profit on his outlay. If the dealer is a professional coir manufacturer, he hands the husks over to women for beating on contract. A woman can beat about 100 nut husks per day and is paid 2 annas 6 pies (equivalent to 10 cents Straits) per 100 nuts. It requires 4,000 to 5,000 green husks to produce 750 lbs. of beaten fibre.

After beating and drying, the fibre is taken over by the dealer, who weighs it and hands over known quantities of fibre to women who usually take it to their homes to twist into yarn. These women are paid two pies (less than a cent Straits) per hank of 132 feet for twisting. A woman can twist from 5 to 8 hanks per day. The twisted yarn is re-weighed by the dealer when he takes it over.

### Government Coconut Research Station.

This Station is about 30 acres in extent and was originally a coconut garden, taken over by Government in 1916. Planting is irregular since a considerable amount of inter-planting has taken place both before and after acquisition. The Station presents a neat and tidy appearance as it is well-bunded, which gives it a terraced effect and also divides up the Station into blocks for experimental purposes. The soil is a very light sandy loam, reddish in colour and the land has a gradual



Government Coconut Research Station, Kasaragod, South Kanara. Showing Halting Bungalow on Station, roof timbers of coconut wood from old palms cut out in 1916.

Government Coconut Research Station, Kasaragod, showing Bunding of Plots, Surface Cultivation, and deep planting of Seedlings.

slope towards the sea which is about $\frac{1}{4}$ mile distant. Bunding is necessary to prevent soil erosion during the monsoon season when over 100 inches of rain falls between the months of May and October. Cultivation is carried out by ploughing with bullocks.

Deep planting is the normal practice but there are also surface-planted palms on the Station and comparative records are being kept of both methods.

It has been found that with surface planting all palms in a given area will come into bearing in 10 years, while it takes 20 years for all palms in a similar area of deep-planted palms to come into bearing.

Individual palm records are kept in all blocks but only palms in the centre of a block are used for recording, *i.e.* a guard row is left inside all bunds. Several blocks are used for manurial and cultivation experiments, the results of which are to be published shortly.

Perhaps the most important feature of the Station is the selection work in progress. Palms are being selected for the following characters:—High yield, high production of female flowers, high setting of fruit, thick meat, large nuts.

The ideal is, of course, a combination of all five characters. It is interesting to note that it has so far been found that there is no correlation between high production of female flowers and high setting capacity. The ultimate aim is to select nuts for planting by the study of morphological characters. Another interesting observation is that development of the leaf and its corresponding spike commences at least $2\frac{1}{2}$ years before nuts on that particular spike are ready for harvesting. Individual palms on this Station have given up to 150 nuts per annum.

Every character of the palm is studied, such as nut size, yielding capacity, oil content of nuts harvested at different ages, and effect of rainfall on setting capacity.

Further results will not be alluded to here since a report on work in progress and results to-date are to be published in a few months in the form of a bulletin entitled "A Monograph on Coconuts" by Dr. Patel, the Officer of the Department of Agriculture in charge of coconut and other oil investigations.

It is of interest to record that timber from some of the old palms removed from this Station when it was first taken over has been used to build the halting bungalow on the Station and for other similar purposes.

**Acknowledgments.**

Certain information contained in this article, particularly that referring to areas under coconuts and average yields, which was obtained first-hand by the writer, has been checked by reference to "A Report on Coconut Enquiry in India" by Dr. J. S. Patel, M.Sc. Ph.D., to whom acknowledgment is made.

The writer wishes to express his thanks to the Director of Agriculture, Madras, (M.R.Ry. Rao Bahadur D. Ananda Rao Garu, B.Sc.) and the Deputy Director

of Agriculture, VII Circle, Tellicherry, (M.R.Ry. K. T. Alwa Avl.) for their ready assistance in arranging the programme of this tour and for allowing one of their Agricultural Demonstrators to accompany him throughout the trip. Special thanks are due to this Demonstrator (M.R.Ry. K. Govindan Nambiar) who acted as guide and interpreter throughout the trip and so willingly gave all the information required regarding the coconut and coir industry on the Malabar district.

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# THE DIETETIC VALUE OF PALM OIL

BY
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Palm oil is employed for culinary purposes in regions where the oil palm is indigenous, but the cultivation of the crop in this country has not led to a similar consumption of palm oil since, as may be expected, the local races prefer the oils to which they are accustomed, coconut, groundnut, or gingelly as the case may be. Palm oil, however, has a dietetic value lacking in the other oils mentioned, in that it is a source of Vitamin A. This vitamin, which promotes growth and resistance to disease, and prevents xerophthalmia, is found in the liver oils of cod and other fish, but apparently does not occur as such in palm oil. It is produced in the body by transformation of carotene, the pigment to which the colour of the oil is due. Carotene, which is found in carrots and many vegetable products, has a chemical structure closely similar to that of Vitamin A, so that its conversion is readily explicable. The fact of conversion has been abundantly demonstrated, and a certain weight of pure carotene has been adopted as the International Unit of Vitamin A.

The value of palm oil for edible purposes, if people could acquire the taste for it, is therefore obvious, particularly as Rosedale (1) has demonstrated that its vitamin activity is not destroyed by ordinary cooking processes. Its use has also been advocated for medicinal purposes or as an adjunct to the ordinary diet, since its Vitamin A activity is more or less equivalent to that of cod liver oil. It should be clearly understood that Vitamin A alone is referred to, for palm oil is practically devoid of the anti-rachitic Vitamin D which is found in cod liver oil. Further, red palm oil only is understood, for a bleached oil has had the carotene destroyed or removed, and any palm oil much exposed to air and light will have undergone serious depletion of its carotene.

The administration of palm oil has been recommended by the medical profession on the grounds discussed above, and has had favourable results, although no large scale clinical trial has been made. The oil has been recommended by Mr. C. Ward-Jackson for puppies (2), and it has also been incorporated in poultry feeds. As is well known, palm oil deposits a solid fat at the prevailing local temperature, and this has been adduced as an objection to its consumption on human food (3). For this reason, the writer has advocated the removal of the solid fraction either by settlement or filtration, leaving a permanently fluid oil judged to be more palatable either as food or medicine (4). It was shown that the solid became progressively whiter as the liquid oil was expressed, and that the separated liquid therefore, must be richer in carotene than the original whole oil. It was further considered on general grounds that an oil of the lowest possible acidity would be most suitable; and the same idea was expressed by Mr. Ward-Jackson who suggested aiming at an acidity of $1\frac{1}{2}$ per cent.

In pursuance of these ideas, assistance was sought from the Manager of Elmina Estate who kindly produced a small batch of oil of low acidity. This oil was filtered in the laboratory, giving a liquid fraction of acidity 1.4 per cent. Samples of the oil were supplied to the Medical Officer, General Hospital, Kuala Lumpur, to the Adviser, Medical and Health Services, Singapore, and to Mr. Ward-Jackson. The second of these was examined by Professor Rosedale at the College of Medicine, who surprisingly reported that its potency was 25 per cent. inferior to that of ordinary estate palm oil obtained from Johore. Dr. Rosedale also stated that in his experience low acidity oils were usually less potent than the more acid ones.

This development was disconcerting at first sight, but since the connexion between free fatty acid and Vitamin A can only be fortuitous, it appeared that the explanation lay in the methods of producing oil of low acidity. It is well-known that with a fixed factory procedure, the acidity of the output is governed by frequency of harvesting and is reduced by shortening the intervals (5). The reason is that when harvesting at short intervals there is less opportunity for fruit to become over-ripe and susceptible to damage before sterilizing, but it also follows that there is more chance of immature bunches being included. It was fairly evident that carotene development would be incomplete in unripe fruit, and that the procedure adopted to secure oil of low acidity would tend therefore to a carotene deficiency. An actual test of different grades of fruit was arranged, to ascertain the magnitude of the differences between them.

Batches of oil were made in the laboratory, the stripped fruit being sterilized in boiling water, depericarped, and pressed in a hand press, the oil being filtered and dried *in vacuo*. The different batches were from:—

(*a*) bunches about one week under-ripe;
(*b*) bunches "just ripe";
(*c*) bunches one week over-ripe;
(*d*) as (*c*) but the stripped fruit allowed to lie about for two days before sterilizing.

The state of ripeness of bunches cannot of course be precisely defined, for any bunch bears fruits varying widely in growth and ripeness. The bunches were chosen according to the usual practical standards.

The acidities of the oils were, expressed as palmitic acid, (*a*) 1.6 per cent., (*b*) 3.3 per cent., (*c*) 3.2 per cent. and (*d*) 15.1 per cent. In appearance, the oil from unripe fruit was markedly different from the others; its colour was brownish yellow.

Samples of each oil were supplied to Professor Rosedale and to Dr. I. A. Simpson, Institute for Medical Research, for test of the Vitamin A potency, both colorimetrically and biologically. With the permission of the Director, Institute for Medical Research, Dr. Simpson carried out the desired investigation and also examined the possibilities of isolating carotene from palm oil. The results of his work are to be published in a Bulletin of the Institute, so that it is necessary here to state only the main findings.

From the effect of the samples on the growth rate of rats it was calculated that their Vitamin A potencies were as follows:—

| | International Units per gramme. |
|---|---|
| (*a*) Oil from under-ripe fruit ... ... ... | 600 |
| (*b*) ,, ripe fruit ... ... ... | 1900 |
| (*c*) ,, over-ripe fruit (low acidity) ... ... | 1600 |
| (*d*) ,, over-ripe fruit (high acidity) ... ... | 800 |

Colorimetric comparison of the oils with standard carotene gave results diverging somewhat from the above. Expressing both sets of results as milligrammes per cent. of carotene the four oils should contain:—

| | By biological assay | By tintometric assay |
|---|---|---|
| (*a*) ... | 36 | 24 |
| (*b*) ... | 114 | 66 |
| (*c*) ... | 96 | 62 |
| (*d*) ... | 48 | 60 |

The discrepancy cannot be explained at the moment, but a discussion of it and details of the methods will be found in Dr. Simpson's forthcoming paper.

The samples sent to Professor Rosedale were examined by him also colorimetrically and biologically but not in precisely the same manner. He compared them with his standard palm oil, expressing their Carr-Price values in terms of blue Lovibond Units per gramme. The figures were:—

| | Blue Units per gramme |
|---|---|
| (*a*) Oil from under-ripe fruit ... ... ... | 8 |
| (*b*) ,, ripe fruit ... ... ... | 180 |
| (*c*) ,, over-ripe fruit (low acidity) ... ... | 130 |
| (*d*) ,, over-ripe fruit (high acidity) ... ... | 135 |
| Standard palm oil ... ... ... | 190 |

For feeding rats, the oil (*a*) had little value, but (*b*) was about equal to the standard oil. Oils (*c*) and (*d*) were not distinguishable on feeding, but it was not possible to breed from the rats supplied with oil (*d*).

The interesting feature from the point of view of the present article is the confirmation of the opinion that oil from immature fruit is deficient in Vitamin A potency, and that production of low-acidity oil by methods tending to include such fruit will result in deficiency to some degree. In the case of over-ripe fruit, the carotene content seems to be largely maintained, though as far as can be judged from one set of experiments on rats the development of acidity is injurious. In the absence of scrutiny of every bunch collected after short harvesting intervals, it appears that the oil as now manufactured on most estates with an acidity of 3 to 4 per cent. will be the most satisfactory in dietetic value.

A further point is the relative value of Malayan and other palm oils compared with fish liver oils. Figures have been published indicating that the carotene content of Malayan palm oil is several times inferior to that of certain West African oils (6). Direct confirmation of this is to be sought at the earliest opportunity, but in the meantime the figures found by Dr. Simpson show that Malayan palm oil containing 1,900 International Units per gramme compares satisfactorily with cod liver oil for which values ranging from 500 to 2,800 are quoted (7). Palm oil may be regarded as equivalent to good average cod liver oil, though not equal to the best. Halibut liver oil and tunny liver oil, for which values of 41,000 and 95,000 respectively are quoted, have a potency of higher order altogether.

Thanks are due to Dr. I. A. Simpson for his collaboration in this investigation and to Dr. A. N. Kingsbury, Director of the Institute for Medical Research, for granting the facilities necessary and permitting pre-review of Dr. Simpson's paper. Professor J. L. Rosedale is also thanked for conducting a parallel series of tests.

## Summary.

Red palm oil may be recommended for culinary or medicinal use on the grounds that it contains carotene, the precursor of Vitamin A. Its potency is such that it may be regarded as a good substitute for cod liver oil, at least in Malaya where there is usually no Vitamin D deficiency.

The palatableness of the oil is increased by removing the solid component, and the resulting liquid is richer in carotene than the original whole oil.

The attainment of low acidity is attended by risk, on account of the serious deficiency in carotene of immature fruit. Reduction of the harvesting interval on estates is therefore apt to be detrimental, and it is probable that, without special precautions to select ripe fruit only, it would be best to rely on oil from the normal output of estates employing bunch sterilization methods.

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# NOTES ON THE PREPARATION OF DERRIS ROOT FOR EXPORT TOGETHER WITH A SUGGESTED METHOD FOR EVALUATION

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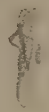


## Introductory.

While correct comparative evaluations of the toxicities of roots of various species of Derris can be obtained only as a result of controlled experiments on different classes of insects, chemical tests constitute the means by which commercial consignments are valued. Thus, at present, the rotenone content and/or the ether extract of the root are invariably used as a basis for valuation purposes.

The adoption of a chemical test raises the question of a standard method of procedure for sampling and analysis to ensure comparable results being obtained by different workers.

Although this question has already been discussed in some detail (1), the growing importance of Derris and the increasing competition to be met from other plants, notably cubé root (*Lonchocarpus* sp.), possessing similar insecticidal properties, justify reconsideration of the subject.

In the present paper, therefore, an account will be given of various experiments carried out recently with Derris root, mainly with the object of standardizing the method of analysis. Further, since the investigation comprised the examination of roots from the more important species of Derris now under cultivation, it will be possible to indicate the quality of root at present being exported from Malaya.

## General Considerations on Preparation of Root for Export.

Apart from the question of moisture content to which reference will be made later, two other important points affecting the quality of the root have emerged as a result of the examination of a large number of commercial samples.

(a) *Washing of Roots.*—The freshly-harvested roots should be washed free from soil before being dried. Although a large proportion of the naturally-adhering soil falls away during the process of drying, there is always a tendency for some to adhere tenaciously if the soil is of a clayey nature, thereby detracting from the appearance of the roots. In such cases the latter will be described subsequently as dusty.

Provided that the cortex has not been injured during harvesting, there is no danger of loss of toxic substances in washing the fresh root with water.

(b) *Selection of Roots.*—In general, only roots with a diameter of half-an-inch or less should be included, the final selection being made when the material

is dry. Roots shrink in size perceptibly on drying, so that if selection is carried out with freshly-harvested material, a proportion of roots which would satisfy the above standard will be excluded.

Some contracts specify a maximum diameter in the air-dry roots of 10 mm., corresponding approximately to 0.4 inches.

In addition, inspection of a large number of commercial consignments has shown that there is a tendency not to harvest the roots to the tips; frequently many roots are found to have been broken off during the process of harvesting. Further, the opinion has been expressed that the very fine roots are deficient both in rotenone and in ether extract.

A series of experiments was therefore carried out with the root systems from plants of various species of Derris to determine the rotenone content and ether extract of roots of varying sizes and the percentage distribution of rotenone and ether extract in the root systems.

The root systems from the individual plants of each species were air-dried, bulked and the roots separated into the following sizes (i) $\frac{1}{2}$ inch to $\frac{1}{4}$ inch (ii) $\frac{1}{4}$ inch to $\frac{1}{8}$ inch (iii) $\frac{1}{8}$ inch and less. The weights of the roots were recorded in each case, after which average samples were drawn for analysis.

The results in Table 1 show that the toxicities of the smallest sized roots compare favourably with those for larger roots; in one instance, *D. elliptica* (Singapore type), the toxicity of the roots having a diameter of $\frac{1}{8}$ inch or less is greater than that of roots varying in diameter from $\frac{1}{4}$ to $\frac{1}{8}$ inch. In this connexion it may be mentioned that the term toxicity applies equally well to the ether extract and to the rotenone content.

Further, the figures in Table II indicate that the smallest sized roots may amount to a considerable proportion of the total yield. Coupled, therefore, with the high toxicity, the results illustrate the importance of harvesting the root systems of the plants as completely as possible.

In addition, the figures also show the absence of any grounds for the attitude adopted by some dealers that the very fine roots are of poor toxic quality, and that they are in consequence justified in offering a much reduced price compared with the larger roots.

## Methods of Analysis.

In view of the advisability of the adoption of a standard method for the valuation of the roots on a chemical basis, the various operations involved will be considered in order of sequence:—

(i) Selection of sample.
(ii) Preparation of root for analysis.
(iii) Determination of moisture.
(iv) Determination of ether extract.
(v) Determination of rotenone.

## Table I.

**Rotenone Content and Ether Extract of Roots of Varying Sizes from Different Species of Derris.**

(Moisture-free Basis)

| Species of Derris | Rotenone | | | Ether Extract | | |
|---|---|---|---|---|---|---|
| | Roots $\frac{1}{2}''$—$\frac{1}{4}''$ | Roots $\frac{1}{4}''$—$\frac{1}{8}''$ | Roots $\frac{1}{8}''$ and less | Roots $\frac{1}{2}''$—$\frac{1}{4}''$ | Roots $\frac{1}{4}''$—$\frac{1}{8}''$ | Roots $\frac{1}{8}''$ and less |
| | per cent. | per cent. | per cent. | per cent. | per cent. | per cent. |
| *D. elliptica* (Singapore type) | No roots | 3.91 | 5.77 | No roots | 20.80 | 21.82 |
| *D. elliptica*, Sarawak creeping | 4.07 | 7.18 | 5.64 | 18.31 | 26.57 | 21.42 |
| *D. malaccensis* var. *sarawakensis* | 3.04 | 2.98 | 2.76 | 22.66 | 20.88 | 18.77 |
| *D. malaccensis* (Kinta type) | Nil | Nil | Nil | 11.44 | 14.57 | 12.43 |

## Table II.

**Distribution of Rotenone and Ether Extract in Roots of Varying Sizes from Different Species of Derris.**

(Moisture-free Basis)

| Species of Derris | No. of Plants | Proportion of Roots | | | Distribution of Rotenone (expressed as percentage of total present) | | | Distribution of Ether Extract (expressed as percentage of total present) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Roots $\frac{1}{2}''$—$\frac{1}{4}''$ | Roots $\frac{1}{4}''$—$\frac{1}{8}''$ | Roots $\frac{1}{8}''$ and less | Roots $\frac{1}{2}''$—$\frac{1}{4}''$ | Roots $\frac{1}{4}''$—$\frac{1}{8}''$ | Roots $\frac{1}{8}''$ and less | Roots $\frac{1}{2}''$—$\frac{1}{4}''$ | Roots $\frac{1}{4}''$—$\frac{1}{8}''$ | Roots $\frac{1}{8}''$ and less |
| | | per cent. | per cent. | per cent. | per cent. | per cent. | per cent. | per cent. | per cent. | per cent. |
| *D. elliptica* (Singapore type) | 3 | No roots | 44.5 | 55.5 | No roots | 33.8 | 66.2 | No roots | 43.3 | 56.7 |
| *D. elliptica*, Sarawak creeping | 3 | 19.5 | 48.2 | 32.3 | 13.1 | 56.9 | 30.0 | 15.3 | 54.9 | 29.8 |
| *D. malaccensis* var. *sarawakensis* | 4 | 17.7 | 38.7 | 43.6 | 18.5 | 40.0 | 41.5 | 19.7 | 40.4 | 39.9 |
| *D. malaccensis* (Kinta type) | 2 | 37.9 | 37.9 | 24.2 | Nil | Nil | Nil | 33.7 | 42.9 | 23.4 |

### (i). Selection of Sample.

The importance of accurate sampling cannot be over-estimated in view of the wide variations existing beween the toxicities of the roots from individual plants. The figures in Table III illustrate the range of variation found for the more important species.

## Table III.

### Variations in Ether Extract of Roots of Individual Plants of Various Species of Derris.

(Moisture-free Basis)

| Species of Derris | No. of Plants | Maximum | Minimum | Average |
|---|---|---|---|---|
| | | per cent. | per cent. | per cent. |
| *D. elliptica* (Singapore type) | 21 | 25.10 | 11.14 | 20.52 |
| -do- | 20 | 28.00 | 18.82 | 23.89 |
| *D. elliptica,* Sarawak creeping | 36 | 29.65 | 5.08 | 24.71 |
| *D. malaccensis* var. *sarawakensis* | 47 | 26.83 | 14.78 | 21.31 |
| -do- | 40 | 25.65 | 6.13 | 19.44 |
| *D. malaccensis* (Kinta type) | 22 | 22.07 | 14.41 | 18.79 |

The results indicate clearly the necessity for a definite sampling procedure if reliance is to be placed upon the results of the subsequent chemical analysis.

There are two essential principles in sampling:

(*a*) Samples must be drawn at regular intervals during the process of packing the consignment.

(*b*) A constant proportion must be maintained between the amount of the sample and the quantity sampled. If possible, the amount of the sample should be not less than one half per cent. by weight of the material sampled.

The general method of packing derris root is in bales, which are press-packed to save space, and samples may be taken while baling is being carried out or when the root has already been baled.

In the first case, it is suggested that, as the root is loaded into the baling press, individual pieces be taken at random at regular intervals so that by the time the press has been loaded, a further amount of root equal to one half per cent. by weight of the bale has been set aside for sampling. For example, in

the case of a bale of 200 lbs. the amount withdrawn for sampling would be 1 lb. A similar procedure would be followed in the case of the other bales.

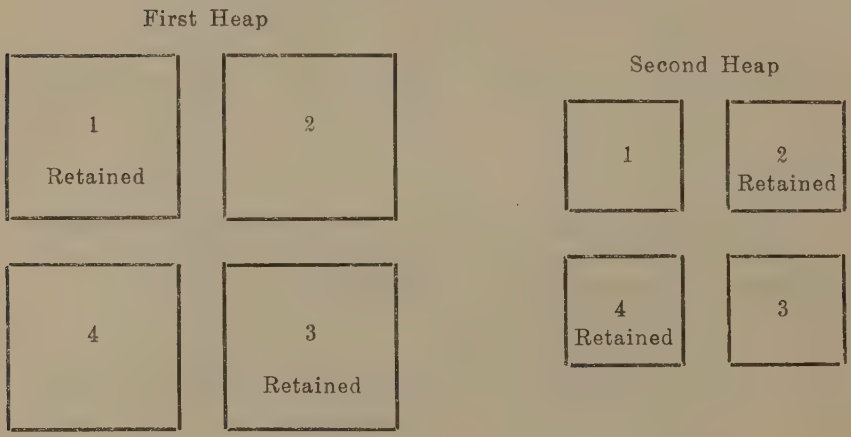
The bulk sample of root should then be chopped into lengths of approximately 6 inches, and the mass mixed and quartered until about 1 lb. of root remains. This amount will be ample for submitting for analysis.

The quartering of the bulk sample is carried out as follows: The mass of root, which has been cut into short lengths, is mixed thoroughly, and the heap smoothed out into the form of a square. The heap is divided by means of a wooden rod into four equal portions as indicated in the diagram. The material in opposite quarters, *i.e.* 1 and 3 or 2 and 4 is mixed and made into a fresh heap; that in the other pair of opposite quarters is set aside.

A similar procedure is followed as regards the second heap of material, except that the root in the pair of opposite quarters set aside on the first occasion is retained. This procedure of selecting material in alternate pairs of opposite quarters is repeated until the requisite amount of root, say 1 lb., remains.

DIAGRAM I.

**Method of Quartering Used in Sampling.**




Although in the case of a large consignment, say 2 tons, a comparatively large amount of root, approximately 23 lbs., is drawn originally for the purpose of obtaining a representative sample, the total amount eventually retained is only about 1 lb. All the root set aside during the process of sampling can be incorporated in one of the bales.

If the root has been packed the opening of individual bales is necessary. In this case it is suggested that 10 per cent. of the bales be opened, and 5 per cent.

by weight of each bale selected for sampling, care being taken to remove individual pieces of root from different parts of the bale.

The samples from the individual bales, equivalent to one-half per cent. by weight of the whole consignment, are bulked, the root chopped into short lengths, and the heap quartered as described previously until approximately 1 lb. of root remains.

To increase the accuracy of the method the bales for sampling should be selected according to a definite procedure. The bales should be numbered serially, and the consignment divided into as many groups as there are bales to be opened, one bale in each group being selected. A definite interval of choice, equivalent to the number of bales in the group, should also be maintained between the selected bales in the individual groups.

An example will make the method clear. A consignment consists of 40 bales, numbered from 1 to 40 inclusive, and the number of bales to be opened is 4. The consignment is divided into 4 groups, each group consisting of 10 bales, *i.e.* 1-10, 11-20, 21-30, 31-40. The interval of choice is 10. Any bale in the first group may be selected, for example No. 4, and by successive additions of 10, the interval of choice, the serial numbers of the succeeding bales are determined, *i.e.* bales, 4, 14, 24, 34.

As regards baled roots, the above method would only be applicable if there were facilities for baling the roots again after sampling had been completed.

It will be realized, therefore, that the more convenient method of drawing an average sample of root is preparatory to baling when the root is loose and individual pieces can be selected without difficulty.

The last point is emphasized, since it has been brought to notice that wide variations in toxicity have been found between samples drawn from different parts of a bale.

### (ii). Preparation of Root for Analysis.

The following is a brief account of the method at present in use. Fresh roots are sun-dried until they can be broken without exudation of plant-juices. The semi-dried roots are then cut into pieces varying from $\frac{1}{4}$ to $\frac{1}{2}$ inch long and the chopped material is further sun-dried until of constant weight.

The material is then quartered for analysis until approximately $\frac{1}{4}$ lb. remains. One hundred grammes are weighed, then ground in a drug mill.

The root is first passed through a disintegrator having spaces 1/32 inch wide, the spaces being approximately $\frac{1}{4}$ inch apart. The material is ground a second time, the disintegrator being replaced by a 1 mm. sieve. The small amount of woody matter remaining is ground separately in a smaller mill and incorporated with the main sample.

During the process of grinding the root, a considerable proportion of the fine fraction passes through into the canvas bag fitted to the mill. Since this fine dust contains a high proportion of solvent soluble material, care must be taken to empty the bag completely on the conclusion of the operation and to recover all the dust. The latter must be reincorporated with the rest of the material.

For example, in one experiment the mixed ground root was passed through a 100 mesh sieve and portions of the two fractions extracted with carbon tetrachloride. The material passing through the 100 mesh sieve corresponds approximately to the fine fraction referred to above.

The results of analysis, calculated on a moisture-free basis, were as follows:—

| | per cent. |
|---|---|
| Coarse fraction ... ... ... ... | 12.3 |
| Fine fraction ... ... ... ... | 33.0 |

It will be seen, therefore, that the amount of solvent extract in the fine fraction is nearly 3 times as much as in the coarse fraction.

To obtain a representative sample of the ground root for analysis, the various fractions are shaken together in a jar provided with a closely-fitting lid, and the required amount of material is weighed before segregation of the fine particles has taken place.

The weight of the finely ground material is checked against that of the original root. There is usually a difference of 1 per cent. in the weights; this can be attributed only to a slight reduction in moisture content consequent upon a rise in temperature of the material during the process of grinding.

### (iii). Determination of Moisture.

The moisture content of the root is of considerable importance from the point of view of valuation of product, the ether extract or rotenone content of the same material varying inversely as the moisture.

Apart, therefore, from the questions of risk of mould development and deterioration in quality consequent upon packing moist material, the producer is well-advised to ensure that the root is air-dry before sale.

The moisture content of the air-dry root varies from 7 to 10 per cent., the lower figure being found during the dry, and the higher figure during the wet season.

Even though the roots are air-dried before despatch, a further small loss in weight will occur during transit, owing to the slow drying out of the material consequent upon less humid atmospheric conditions. This small reduction in moisture content is inevitable, and is a recognized feature in the shipment of other products, for example, palm kernels.

With air-dry roots the loss in weight is not serious and, even with roots harvested in the wet season, the amount is only approximately 4 per cent., calculated on the original weight. The loss should not, however, exceed 2 per cent. for roots packed in the dry season.

If, therefore, roots are despatched without being adequately dried, in addition to an excessive loss in weight in transit for which the exporter will be penalized, the buyer receives the benefit of an increase in the amount of ether extract and/or rotenone content, consequent upon the reduced moisture content of the material. It is therefore essential for the producer in his own interests to ensure that the root is dry before sale. This point cannot be emphasized too strongly, since

samples from commercial consignments have been received in which moisture contents of 12 and even 14 per cent. have been recorded.

As regards determination of moisture, all samples of root are weighed on arrival, any loss in weight occurring before the sample for analysis is drawn, being calculated as moisture, and an adjustment made when the moisture content of the finely-ground material has been determined.

In those cases, however, in which only a moisture determination is required, the most convenient method is to distil the finely-chopped root with xylene, measuring the amount of water which collects on distillation.

Similarly, the moisture content of the finely-ground root may be determined either by distillation with xylene or by drying to constant weight in the steam-oven at 100°C.

The results of our experiments have shown the method of distillation to be preferable owing to the elimination of any oxidation effect due to heating in air material in a finely-ground condition (1). The distillation method is therefore used when dealing with individual samples; where large numbers of samples are involved, however, the alternative method is employed by reason of a more rapid rate of working.

### (iv). Determination of Ether Extract.

Although different solvents have been suggested for the determination of the amount of extract (1), ether is the solvent invariably specified when selling the root under contract.

A weighed amount, approximately 5 grammes, of the finely ground root is treated with ether in a Soxhlet extractor for 16 hours at a temperature just sufficiently high to allow the solvent to boil gently.

Experiments have shown that with this amount of material, the above period is sufficient to ensure complete solvent extraction, no appreciable quantity of extract being recovered on grinding the residue with a small proportion of sharp sand, and extracting the mixture with more ether.

The ethereal solution is filtered if necessary to remove traces of suspended matter, the solvent distilled off and the residue dried to constant weight in the steam-oven, weighings being recorded every two hours.

Although the results of our experiments have shown that slight chemical changes take place by drying the ether extract under such conditions and it would therefore be preferable to dry to constant weight *in vacuo*, the method of drying in the steam oven has the advantage of being more rapid, constant weight being reached usually after heating for 6 hours. This method is therefore invariably used when determining the amount of extract in the root.

### (v). Determination of Rotenone.

The question of an accurate method for the estimation of rotenone is of the utmost importance in view of the higher price paid for root on this basis compared with ether extract. At present, root sold on a rotenone basis is valued at $48 per picul, compared with $33 per picul for that sold on an ether extract basis.

Unfortunately no specific quantitative chemical reaction is yet known by means of which rotenone can be separated as a complex or compound in a high state of purity from the other substances with which it is associated, and the methods at present in use depend in the original instance upon crystallization from a cold concentrated solvent extract of the root. In general, one of two solvents is employed, ether or carbon tetrachloride. In the case of ether, rotenone crystallizes as such, but with carbon tetrachloride, rotenone separates as a complex containing one molecule of solvent of crystallization.

Although rotenone is an easily crystallizable substance the crystals will occlude a varying proportion of the substances dissolved in the mother liquor. These substances consist principally of uncrystallizable resins. The latter cannot be removed entirely by washing the crystals with fresh solvent, partly owing to the risk of dissolving some of the rotenone, and partly owing to the presence of some of the mother liquor within the crystal agglomerates.

It will be realized also that the greater the degree to which the solution is concentrated before crystallization the greater the chances of contamination. The degree of concentration necessary for satisfactory crystallization varies with the proportion of rotenone to total extract. It can be calculated, for example, that with root of *D. malaccensis* var. *sarawakensis* yielding 20 per cent. of extract the concentration of the solution before crystallization will amount to approximately 40 grammes per 100 cc., assuming 50 grammes of the root to have been used and the volume of the extract reduced to 25 cc.

Any method which depends solely on the weight of a crude crystalline product must yield variable results in the hands of different workers owing to differences in the conditions of the experiment, for example, the degree of concentration before crystallization occurs, the rate of crystallization, and the amount of solvent used in washing the crystals.

Further, in the writers' opinion it is unfair to base the price of the root on a figure for the weight of a compound of an unknown degree of purity.

A standard method of determination is therefore urgently required so that comparable results may be obtained by different workers.

The following method, using carbon tetrachloride as a solvent, has been tentatively adopted in this Department. The method, which gives concordant results, is based on that already published (1), the chief difference being that trituration of the crude carbon tetrachloride complex with cold alcohol as described by Cahn and Boam (2), has replaced recrystallization from boiling alcohol.

From 20 to 50 grammes of the finely-ground root, the amount being based on the approximate rotenone content if known, are weighed out and extracted with carbon tetrachloride for 8 hours in a Soxhlet extractor. The thimble is removed from the extractor, the partially exhausted powder dried, lightly ground in a mortar and replaced in the thimble. Extraction is continued for a further 8 hours, making 16 hours in all.

The solution is filtered and concentrated to a point at which it commences to thicken. The solution is allowed to cool to air temperature and, if there is no

tendency for the solution to crystallize, a few crystals of pure rotenone are added to induce crystallization. The flask is corked and allowed to stand in the cold cabinet overnight at a temperature of approximately 5°C.

The crystalline precipitate (which consists of an impure rotenone-carbon tetrachloride complex) is filtered on a tared Gooch crucible, using a paper-disc filter, and washed with 10 to 15 cc. of ice-cold carbon tetrachloride according to the amount of the precipitate.

The crucible containing the precipitate is allowed to stand in the air for 24 hours, after which the contents are transferred to a mortar and ground to powder. The powdered material is replaced in the crucible and allowed to stand in the air till the weight is constant. A period of 3 hours is usually sufficient.

The weight of the complex should not exceed 4 grammes, otherwise there will be difficulty in washing the precipitate satisfactorily. The amount of root originally weighed out should be adjusted accordingly.

The carbon tetrachloride complex is transferred to a flask and triturated with 95 per cent. alcohol saturated with rotenone in the proportion of 5 cc. of alcohol to 1 gramme of complex.

The flask is allowed to stand overnight and the crystalline rotenone precipitate filtered on a tared Gooch crucible, using a paper disc filter. The precipitate is washed with alcohol saturated with rotenone until the filtrate is colourless. Usually 10 to 15 cc. are sufficient. The precipitate is dried in the steam-oven to constant weight.

The above method works satisfactorily with all species of Derris in which the rotenone content exceeds 15 per cent. of the solvent extract. In the case, however, of *D. malaccensis* (Kinta type) in which the proportion of rotenone is of the order of 2 per cent., crystallization of the carbon tetrachloride solution must be induced by the addition of an amount of rotenone sufficient to raise the proportion of that substance to approximately 30 per cent. The latter figure represents approximately the proportion of rotenone present in the extract from *D. elliptica* (Singapore type), with which no difficulty is ever experienced as regards crystallization of the carbon tetrachloride complex.

The necessity for the addition of rotenone to induce crystallization as described above was originally mentioned by Cahn and Boam and acknowledgment of their work is hereby made (2).

To give an indication of the accuracy of the above method the following figures which were obtained as a result of quadruplicate analyses of one sample may be quoted: 7.61, 7.71, 7.60, 7.51, average 7.62 per cent.

Although the method yields concordant results it is possible that the final figure may not represent the total rotenone content of the root but rather the amount of rotenone that can be recovered under the conditions of the experiment. Rotenone may be lost at one or two stages of the process, thus some may not crystallize out from the carbon tetrachloride but may remain associated with resinous bodies in the mother liquor, while some may pass into solution when the

complex is triturated with alcohol. While our experiments have shown that these losses are not likely to be serious the questions are considered of sufficient importance to warrant further investigation.

From the point of view of a commercial valuation, a marked disadvantage of the method is the length of time which the process occupies, and the opinion has been expressed that it might be possible to adopt the weight of the air-dry carbon tetrachloride complex as a standard for calculating the weight of rotenone after the introduction of an appropriate correction factor. This would also obviate one source of loss of rotenone. In the case of the pure complex the weight of pure rotenone can be calculated by multiplying the weight of the complex by the factor 0.719.

Experiments have shown that the purity of the complex varies both with roots from the same species and from different species. For example, in a series of 21 determinations of rotenone in *D. elliptica* (Singapore type) the proportion of the recovered weight of rotenone to the weight calculated from that of the complex varied from 66.3 to 87.2 per cent., with an average of 80.3 per cent. Further, in the case of *D. malaccensis* var. *sarawakensis* the proportion does not exceed 70 per cent.

Apart from the question of the possibility of a small loss of rotenone on treating the complex with alcohol, it is considered that the range of variation of purity of the complex is too wide to admit of the introduction of a correction factor and, therefore, it is impossible to recommend the weight of the complex as a standard on which to base the rotenone content. While the result would favour the producer, the figure would be fictitious and might well give rise to a complete misunderstanding as regards the value of a consignment of root if the buyer contemplated the recovery of rotenone.

A similar suggestion was made when ether was being used as a solvent, the weight of the crude crystalline precipitate being taken as a basis for calculating the rotenone content. It has been shown previously (1) that such a procedure is also unsatisfactory owing to the variation in the degree of purity of the precipitate.

Unfortunately the weight of the crude carbon tetrachloride complex is being often used at present as a basis for calculation, thereby accounting for an undue apparent richness in rotenone in some samples of root. In this connexion it may be mentioned that in another series of samples of *D. elliptica* (Singapore type) in which the figures for rotenone, weighing the recrystallized product, varied from 6.00 to 7.16 per cent., those based on the weight of crude complex varied from 7.13 to 10.76 per cent.

The importance of the adoption of a standard method for the estimation of rotenone, in which the latter is weighed as a pure product, is urged most strongly, as it is maintained that the interests of the industry would best be served by adopting a method which would place the determination of this relatively important

constituent on a basis in which purity of product as judged by the present accepted standards would be unquestioned.

**Observations on Present Quality of Malayan Derris Root.**

The three principal centres in which this crop is at present being cultivated are Johore, Perak and Singapore, of which the most important is Johore.

According to the returns for 1935 the total area planted in Malaya amounted to 6,439 acres, the details for the respective centres being as follows:—

| Centre of Production | | Area Planted | Proportion of Total Area |
|---|---|---|---|
| | | acres | per cent. |
| Johore | ... | 3,918 | 60.8 |
| Perak | ... | 1,028 | 15.3 |
| Singapore | ... | 750 | 11.6 |

As far as can be ascertained, *D. elliptica* (Singapore type) is the species commonly cultivated both in Johore and Singapore, while in Perak the species is *D. malaccensis* (Kinta type).

Reference to previous work (3) (4) will show that bulk samples of *D. elliptica* (Singapore type) are generally characterized by a high rotenone content combined with a high ether extract.

The results of analysis of samples from Changi, Singapore, show that the composition of the air-dry root from plants harvested at 18 months intervals varies as follows:—

| | | | | per cent. |
|---|---|---|---|---|
| Rotenone | ... | ... | ... | 5 to 6 |
| Ether Extract | ... | ... | ... | 18 to 22 |

There should be, therefore, little difficulty in this root meeting the present requirements of the market as far as rotenone content is concerned, the present standard for which is either 4 or 5 per cent., usually the latter. The root would also satisfy the standard if sold on an ether extract basis, which is generally fixed at 18 per cent.

Frequently, however, consignments of roots of this species are offered in which both the rotenone content and the ether extract are below these figures. Assuming that sampling has been carried out satisfactorily, the lower figures can be ascribed either to the age of harvesting or to a poor strain of plant. The question of the variation in toxicity between individual plants has already been discussed (4).

*D. malaccensis* (Kinta type) is characterized by a very low rotenone content, combined with a moderately high ether extract. For practical purposes the root may be regarded as rotenone-free, the rotenone content seldom exceeding 0.5 per cent. The ether extract of the air-dry root is approximately 18 per cent., so that this species can also satisfy the market requirements for root sold on an ether extract basis.

**References.**

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2. Cahn, R. S. and Boam, J. J. Determination of Rotenone in Derris Root and Resin. *Journal of the Society of Chemical Industry,* Vol. LIV, No. 8, 1935, page 37T.
3. Georgi, C. D. V., Greig, J. L. and Gunn Lay Teik. Varietal and Manurial Trials with Derris. *Malayan Agricultural Journal,* Vol. XXIV, No. 6, June 1936, page 268.
4. Georgi, C. D. V., Lambourne, J. and Gunn Lay Teik. Preliminary Selection Experiments with Derris. *Malayan Agricultural Journal,* Vol. XXIV, No. 8, August 1936, page 374.

*Received for publication 26th August, 1936.*

# Abstract.

## TWENTY-SEVENTH REPORT ON NATIVE RUBBER CULTIVATION IN THE NETHERLANDS INDIES.*

### Prices.

The Batavia quotation for Java standard sheet at the beginning of the quarter under review was 23 guilder-cents per ½ kgm. By the middle of April it went up to 23¾ cents, but towards the end of the month it dropped again to 23 cents. During the first half of May the price continued to decline until it reached 22½ cents around the 12th of the month; during the second half of May, the quotation fluctuated several times between 22¾ and 23⅜ cents, to stand again finally at 23 cents at the end of the month. During the month of June the quotation moved sharply upwards and reached the level of 23⅞ cents on June 26th. In the first half of July a further advance followed to 24½ cents.

The half-monthly averages of the daily quotations for Java standard sheet at Batavia in the period from April 1st to July 15th were consecutively: 23.3, 23.5, 22.8, 22.9, 23.1, 23.2 and 24.1 guilder-cents per ½ kgm.

During the quarter under review prices were considerably higher than those in the preceding quarter. The somewhat weaker tendency in May is a result of two factors, namely, the decision of the International Rubber Regulation Committee made on April 28th to reduce the restriction percentage for the second half of 1936 from 40 to 35 per cent., and the outcome of the election in France, from which a possible devaluation of the franc was anticipated. The internally sound position of the rubber market, however, again resulted in a price recovery. A great stimulus was given by the satisfactory progress of consumption in the United States and by the steady decline in the stocks of rubber.

The trend of prices was always closely followed by increases and decreases in the extraordinary export duty on native-grown rubber. In the early part of April the tax in force was 33 cents per kgm. dry native-grown rubber. The advancing prices in the beginning of the quarter under review caused it to be raised to 34 and 35 cents on April 6th and April 19th respectively. The price decline in the first half of May was followed by reductions on May 8th and May 11th to 34 and 33 cents respectively. On May 19th, however, the export tax was again raised to 34 cents. The continued price advance in June, and particularly towards the end of the month and the beginning of July, made further increases necessary, namely to 35 and 36 cents on June 24th and July 9th respectively. The difference between the price of standard sheet at Batavia and the extraordinary export duty was thereby retained at about 7 cents per ½ kgm.

The prices of medium blanket in Singapore fluctuated, during the quarter under review, between the price of standard sheet and a level 1½ per cent. below this.

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* Abstract from *The Netherlands Indies*, Vol. IV Nos. 14-15, August 1, 1936.

## Table I.

### Quarterly Exports of Native-grown Rubber in Metric Tons.

(dry equivalent).

| | Group 1a blankets | Group 1b sheets | Group 11a scraps | Group 11b slabs | Total | 1a + 1b in per cent. of total |
|---|---|---|---|---|---|---|
| 1935 | | | | | | |
| 1st quarter ... | 8,299 | 7,924 | 953 | 18,863 | 36,039 | 45.2 |
| 2nd „ ... | 13,851 | 15,508 | 1,009 | 20,646 | 51,014 | 57.7 |
| 3rd „ ... | 10,230 | 9,514 | 19 | 8,097 | 27,860 | 70.9 |
| 4th „ ... | 13,104 | 12,452 | 16 | 4,361 | 29,933 | 85.4 |
| Total ... | 45,484 | 45,398 | 1,997 | 51,967 | 143,846 | 62.7 |
| 1936 | | | | | | |
| 1st quarter (final figures) ... | | | | | | |
| Acheen ... | 4 | 24 | — | 50 | 78 | 36.0 |
| Sumatra's East Coast ... | 1,617 | 472 | 76 | 2,191 | 4,356 | 48.0 |
| Tapanuli ... | 343 | 885 | — | 1 | 1,229 | 100.0 |
| Sumatra's West Coast ... | 369 | 8 | — | 10 | 387 | 97.0 |
| Rhio ... | — | 1,871 | 86 | 295 | 2,252 | 83.0 |
| Banka ... | — | 354 | — | 1 | 355 | 100.0 |
| Djambi ... | 1,386 | 3,582 | — | 148 | 5,116 | 97.0 |
| Palembang ... | 2,023 | 183 | — | 3,675 | 5,886 | 37.5 |
| Western Borneo ... | 4,172 | 5,190 | — | — | 9,362 | 100.0 |
| S. & E. Borneo ... | 5,204 | 2,504 | — | 487 | 6,195 | 92.5 |
| Total ... | 13,123 | 15,073 | 162 | 6,858 | 35,216 | 80.1 |
| 2nd quarter (provisional) | | | | | | |
| Acheen ... | 1 | 36 | — | 15 | 52 | 71.0 |
| Sumatra's East Coast ... | 1,223 | 309 | 22 | 2,403 | 3,957 | 38.7 |
| Tapanuli ... | 414 | 703 | — | — | 1,117 | 100.0 |
| Sumatra's West Coast ... | 513 | 9 | — | 27 | 549 | 95.0 |
| Rhio ... | — | 1,720 | 112 | 782 | 2,614 | 65.8 |
| Banka ... | — | 569 | — | — | 369 | 100.0 |
| Djambi ... | 1,708 | 4,086 | — | 140 | 5,934 | 97.6 |
| Palembang ... | 2,215 | 91 | — | 3,285 | 5,591 | 41.2 |
| Western Borneo ... | 4,043 | 5,795 | — | — | 9,838 | 100.0 |
| S. & E. Borneo ... | 4,196 | 3,952 | — | 227 | 8,375 | 97.3 |
| Total ... | 14,313 | 17,070 | 134 | 6,879 | 38,396 | 81.7 |

## Exports.

During the second quarter of 1936 exports of native-grown rubber amounted to 38,398 tons,* an excess of 1,564 tons over the allotted quota of 36,834 tons.†

During the entire first half of 1936, exports totalled 73,584 tons, (excluding the 30 tons which were for the account of the 1935 restriction year), or 83 tons below the allotted quota of 75,667 tons, so that it may be said that the allotted quota has practically been filled.

In this connexion, it should be pointed out that the regions with individual restriction have exported less than the allotted quota.

In Table 1 a review is given of the quarterly exports of native-grown rubber, divided into the four groups that are classified in the export statistics.

Compared with the first quarter of 1936, the share of dry rubber in the exports has increased slightly during the second quarter, namely from 80.1 per cent. to 81.7 per cent. The increase in exports is entirely accounted for by groups 1a and 1b, blankets and sheets, the exports of groups 11a and 11b, scraps and slabs, together remaining fairly constant.

The exports of these types of dry native-grown rubber are still finding their way largely to Singapore and Penang. Direct exports of native-made sheets to the United States show, however, quite a steady and not insignificant increase.

## Registration of Native Plantations, and Experimental Tappings.

The registration of native rubber plantations is progressing satisfactorily. It is expected that the greater part of the field work of the 135 enumeration brigades will have been completed by the end of August. As already stated in the previous report, the data received in Batavia are being regularly compiled in the Central Bureau for Native Rubber Registration into the regional card and punch-plate registers that are required for the introduction of the restriction on an individual basis.

The preliminary results of the 850 experimental tappings required for the interpretation of the plantation data collected have already been worked up. In order to obtain as reliable an insight as possible into the factors which might affect production it was decided that a large number of experiments be continued till the end of 1936.

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* Provisional figures, since the figures for June are not yet final.

† In this export quota, the increase in the Netherlands Indian basic quota, which has entirely been devoted to the advantage of the native quota, and the cancelling as a liability, at the end of 1935, of the amount exported by the Netherlands Indies in excess of its export quota have been taken into consideration.

# Review.

## Two Insects of the Vanda Joaquim Orchid Flower.

*By G. H. Corbett, Government Entomologist, and Abu Hassan, Malay Agricultural Assistant. The M.A.H.A. Magazine, Vol. VI, No. 4, October, 1936.*

In this paper, the writers discuss in non-technical terms two insects, one a beetle, *Lema pectoralis* Baly, and the other a thrips, *Anaphothrips corbetti* Priesner, which are always associated with the flower of the Joaquim orchid unless careful attention is bestowed on their control.

The brief descriptions and illustrations of the egg, grub, cocoon and adult will enable the reader to identity the stages of the beetle; the notes on the life history of the beetle and of a parasite of the grub will be found interesting, and the control measures consisting in the collection of all stages of the beetle will, it is stated, prove satisfactory.

The thrips, *Anaphothrips corbetti* Priesner, has only comparatively recently been associated with the Joaquim orchid and in those gardens where tuba is regularly used resulting in the production of perfect orchid blooms, this is, quite unknowingly, probably due to the control of this insect. This thrips is very minute but its presence is readily revealed by small malformed flowers with a brownish discolouration of the petals and, in severe infestations, by yellow and black buds and by a brownish scabby appearance of the flower stem.

Whilst hand collection of all stages for the control of *Lema pectoralis* is recommended, spraying with either a soap, tuba or nicotine sulphate solution for the control of *Anaphothrips corbetti* is advised.

This is a useful paper which will be found of considerable interest to lovers of the Vanda Joaquim and other orchids in Malaya.

(*Contributed*).

# DERRIS CULTIVATION IN PERAK.

*Malayan Agricultural Journal*, September 1936.

The author wishes to make it clear that the possibility of assigning the Kinta Derris to the species *malaccensis* has occurred to other workers in this field. Recent work (to appear as part of an article in the *Journal of the Society of Chemical Industry* by Dr. Buckley of this Department) lends support to this indentification on biochemical grounds. The article was concerned only to suggest identity with the particular type originally described by Prain as *D. malaccensis*.

J. N. M.

# Departmental.

## FROM THE DISTRICTS.

*Compiled by the Chief Field Officer from Monthly Reports from Agricultural Officers.*

**September 1936.**

### The Weather.

With the exception of a few areas the rainfall for September was below the average for the month throughout the Peninsula. Spells of dry weather, unusual for September, occurred in many areas; in Province Wellesley, for instance, intermittent rain fell during the first half of the month, followed by a dry period until the last few days of the month, when heavy showers fell. On the other hand, most of Selangor's rain fell during the second and third weeks of the month.

Exceptions to the general sub-normal rainfall are provided by Kedah, where precipitation was well above average and the Jelebu and Kuala Pilah Districts of Negri Sembilan.

### Remarks on Crops.

*Padi.*—In Kedah, planting was completed in the north and proceeded well elsewhere under satisfactory conditions. Heavy rainfall coinciding with high tides caused some flooding in Kota Star and Kuala Muda Districts, but the plants were sufficiently large to withstand it without much damage. In Province Wellesley, the low rainfall delayed planting somewhat, but in the earlier planted areas the crop has made satisfactory growth. The shortage of water in the south-eastern portion of Krian District of Perak has resulted in delayed planting, a check in growth of such of the crop as had already been planted and renewed weed growth on many areas which occasioned a second or even third *tajak*. Planting was also late in the north-west of the District, although this area did not suffer from water shortage to the same extent. In Perak North and Central, planting has been completed or is nearing completion. Water shortage has occasioned delay in a few areas. In the Sungei Manik area of Lower Perak, planting has proceeded steadily and under generally satisfactory conditions in Stage I. In Stage II, however, irregularities in levels over the area have shown that considerably more internal bunding than has been done on Stage I will be necessary to make satisfactory use of the irrigation water which is available in sufficient quantity in the canals. In Selangor, water shortage still remains a serious problem in practically all areas in Kuala Selangor District, including Panchang Bedena and Tanjong Karang. At Panchang Bedena, rain has revived the yellowing plants in nurseries, but conditions are not yet suitable for planting, the water in the drains being some two feet below soil level. The Beranang River valley area served by the new irrigation system will not be planted this year, as the majority of the cultivators were averse to making a start immediately the irrigation works were

completed and so missed the opportunity of planting. In Negri Sembilan, the position is satisfactory except in Kuala Pilah, where times of planting have been irregular. In Malacca, planting was completed and growth is generally satisfactory. Some water shortage was experienced on areas which lack irrigation facilities. Reports on the crop from Pahang are generally satisfactory, except that water shortage due to low rainfall in Kuala Kuantan delayed planting somewhat in the Sungei Blat area. At the end of the month the position here had improved and was reported to be satisfactory, irrigation water being available in sufficient quantity. Reports from Kelantan are more optimistic than those of the past two months. The weather has favoured ease of cultivation in respect of dry padi and the transplanting of long term wet padi is being carried out with remarkable rapidity.

*Rubber*.—Prices for small-holders' rubber covered by coupons remain substantially the same as for last month and no very great difference in the prices ruling for coupons or uncouponed rubber is reported from anywhere. During the month, fifteen further smoke cabinets were erected by small-holders, four in Perak, two in East Pahang and nine in Central Johore. Reports again show that the advantage or otherwise to a small-holder of smoking his rubber varies considerably according to circumstances. Thus it is stated that in Province Wellesley the narrow price margin between Standard Sheet and low F.A.Q. makes it unprofitable for small-holders who have erected smoke cabinets to work them, it being advantageous for them to sell unsmoked sheet. Similarly, a smoke cabinet erected at Kuang in Selangor is not in use, as the local dealer refuses to purchase smoked sheet. On the other hand the Agricultural Officer, Johore Central, where nine smoke cabinets were erected during the month, states that the increased price received by small-holders for smoked sheet makes it worth-while for them to smoke all their sheet. This same officer, however, reports that the position in the Bekok area differs, in that there, the narrow margin between grades provides no incentive for the small-holder to effect any improvement in the preparation of his product. The State Agricultural Officer, Pahang, reports that the scheme obtaining in that State, whereby each dealer displays samples of various grades together with the price offered for each, is working smoothly. It is convenient here to record that consideration has been given to the possibility of inaugurating similar schemes elsewhere, but the general opinion is that, although the scheme may be suited to Pahang conditions, it is not suitable for adoption elsewhere.

*Coconuts*.—The price of copra showed a further slight advance, the highest Penang quotation for sundried being $6.05 per picul. In Province Wellesley and Penang the seasonal decline in crop production has been more marked than usual. One cabinet kiln was erected in Johore Central Circle and five were under construction in the Klang District of Selangor. This renewed activity in the Klang area is the result of the attendance of a number of cultivators at a course of instruction at the Klang Coconut Station which was arranged in connexion with the course in various subjects held annually for Penghulus of the Federated Malay States and Straits Settlements. As only one Penghulu came forward for the copra section of the course, a number of Klang coconut cultivators were got together at

short notice to attend. The Chinese venture at Benut mentioned last month has ended disastrously, for all four kilns erected were burnt down on the 14th September. A further kiln, erected last month in South Perak, was burnt down. In both instances there are reasons to believe that the firing methods advocated by the Department were not followed and, in the case of the Benut kilns, there was also a departure from the dimensions recommended. These instances serve to show the advisability of adhering closely to instructions, both as regards firing and construction. If properly constructed and fired, the danger from fire with the cabinet kilns is very small as has been exemplified at Klang Coconut Station where a number of cabinet kilns of varying sizes have been in use over a long period.

*Tuba.*—The cultivation of tuba root still continues to extend in Perak South and interest in the crop is well maintained in Johore, whilst tentative enquiries have been made regarding the crop by Malay small-holders in Pahang.

**Agricultural Stations and Test Plots.**

*Agricultural Stations.*—The planting of further fruit trees was done at Gajah Mati Station in Kedah and at Bukit Mertajam Station in Province Wellesley. At Selama Station in Perak, some budding of rambutans was done. At this Station two rambutans that fruited are of very poor quality and will be removed. These two trees were planted as marcots obtained from a privately owned fruit orchard which has a reputation for high quality rambutans. Results serve to emphasise the care necessary to make quite certain of the quality of the fruit planted at Agricultural Stations.

*Padi Stations and Test Plots.*—Scarcity of water through low rainfall has been experienced at Sungei Acheh Test Plot in Province Wellesley, at Titi Serong Station and Briah and Selinsing Test Plots in Krian, at Tanjong Karang and Panchang Bedena Test Plots in Selangor, at Pulau Gadong Station in Malacca and at Kuala Lipis and Sungei Blat Test Plots in Pahang. This has occasioned, in some instances, delayed planting, in others, difficulties with weed growth, and in others, a check to the growing padi. At Kendong Test Plot in Negri Sembilan, marked increased growth is recorded from plots that received a heavy dressing of green manures and also on the plots that last season received heavy dressings of phosphates.

# DEPARTMENTAL NOTES.

### Visits of the Adviser on Agriculture.

The Acting Adviser visited Kelantan and Trengganu during the period September 21st to 28th for the purpose of advising on agricultural work in progress in those States. On the return journey to Headquarters he inspected Agricultural Stations at Kuala Lipis and Raub, and Padi Test Stations at Kuala Lipis and Dong in Pahang.

### Agricultural Leaflets.

The Agricultural Series of free leaflets has recently been extended by the issue of Nos. 11, 12 and 14, on Gambier, Cloves, and Sweet Potato respectively. No. 13, Maize, is at present in preparation, and will shortly be available.

A full list of leaflets and other Departmental publications is printed on the cover of this Journal.

### Rural Lecture Caravan.

The Rural Lecture Caravan continued its tour of Pahang during the period 5th to 26th September, eleven centres being visited. In August, eleven centres only were visited and not twenty as mentioned in the September Departmental Notes.

It is estimated that about 16,500 people witnessed the shows throughout the tour of twenty-two centres.

### Appointments.

Mr. E. J. H. Berwick, B.A., A.I.C.T.A., Dip. Agric. Sci. (Cantab), has been appointed to be an Agricultural Officer, Department of Agriculture, Straits Settlements and Federated Malay States, with effect from 5th September 1936. Mr. Berwick arrived in Malaya on 1st October, 1936, and assumed duty as Agricultural Officer, Perak Central.

# Statistical.

## MARKET PRICES.

### September, 1936.

### Major Crops.

*Rubber.*—The market continued steady throughout the month, with an upward tendency at the close. Spot loose opened in Singapore at 26⅝ cents per lb. and closed at 27 1/16 cents. The average price for the month of No. 1 X. Rubber Sheet was 26.65 cents per lb. as compared with 26.59 cents in August. The London average price was 7.68 pence per lb., and the New York price 16.36 cents gold, as compared with 7.58 pence, and 16.17 cents gold in August.

Prices paid for small-holders' rubber at three centres during the month are shewn in the following table.

### Table I.

### Weekly Prices Paid By Local Dealers for Small-Holders' Rubber, September, 1936.

(Dollars per Picul.)

| Grades. | Kuala Pilah, Negri Sembilan. | | | Kuala Kangsar, Perak. | | | | Batu Pahat, Johore. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3 | 10 | 24 | 2 | 9 | 23 | 30 | 2 | 9 | 16 | 23 | 30 |
| Smoked sheet | 34.00 | | 33.50 | 33.91 | 33.50 | | 33.60 | | 33.50 | | | |
| Unsmoked sheet | 32.50 | 33.00 | 33.00 | | 31.20 | 32.00 | 32.00 | 32.20 | 32.25 | 32.25 | 32.40 | 31.50 |
| Scrap | | | | | | | | | | | | |

Transport by F.M.S.R. lorry service Kuala Pilah to Seremban 12 cents per picul, to Malacca excluding duty, 25 cents per picul, by rail Seremban to Penang $1.24 per picul, Seremban to Singapore $8.00 per ton.

Transport from Batu Pahat to Singapore by lorry excluding duty, 90 cents per picul.

Transport from Kuala Kangsar to Prai by railway $6.20 per ton.

Transport from Kuala Kangsar to Singapore by railway $10.00 per ton (minimum consignment 5 tons).

At Kuala Pilah the standard deduction for moisture in unsmoked sheet is 5 per cent.

At Kuala Kangsar the standard deduction for moisture in unsmoked sheet is 10 per cent.

No purchases at Kuala Kangsar on the 16th September, and at Kuala Pilah on the 17th September.

*Palm Oil.*—The market maintained its improved condition, and prices continued to rise. Quotations for the Malayan commodities are given in Table II.

**Table II.**
**Prices of Palm Oil and Palm Kernels.**

| Date 1936. | Palm Oil in Bulk, c i.f. landed weight Liverpool/ Halifax. | Palm Kernels, c.i.f. landed weight London/ Continent |
|---|---|---|
| | per ton | per ton |
| September 4 | £ 20. 10. 0 | £ 11. 0. 0 |
| ,, 11 | 20. 10. 0 | 11. 0. 0 |
| ,, 18 | 22. 0. 0 | 11. 5. 0 |
| ,, 25 | 22. 0. 0 | 11. 10. 0 |

*Copra.*—Prices improved slightly in the middle of the month, but weakened at the close. The sun-dried grade opened at $5.55 per picul, and improved to $5.80 on the 15th September, closing at $5.40 per picul. The average price for the month was $5.58 per picul as compared with $5.40 in August. The mixed quality averaged $5 per picul as compared with $4.85 in the previous month.

Copra cake remained unchanged throughout the month at $2 per picul.

*Rice.*—The average wholesale prices of rice per picul in Singapore in August were as follows:—Siam No. 2 (ordinary) $3.85, Rangoon No. 1 $3.47, Saigon No. 1 $3.57, as compared with $3.62, $3.45 and $3.50 respectively in July. The corresponding prices in August 1935 were $4.05, $3.60 and $3.62.

The average retail market prices in cents per gantang of No. 2 Siam rice in August were: Singapore 26, Penang 30, Malacca 26, as compared with 28, 30 and 26 respectively in July.

The average declared trade value of imports of rice in August was $3.52 per picul, as compared with $3.57 in July, and $3.64 in June.

*Padi.*—The Krian Government Rice Mill continued to pay $1.90 per picul. Retail prices of padi ranged from 6 to 13 cents per gantang.

*Pineapples.*—Prices per case continued unchanged throughout the month at: Cubes $3.40, Sliced Flat $3.10, Sliced Tall $3.40.

Prices of fresh fruit per 100 were as follows: Singapore $2.50 to $3.50; Selangor $1.20 to $2; Johore 1st quality $2 to 3, 2nd quality $1.50 to $3, 3rd quality 60 cents to $1.50.

**Beverages.**

*Tea.*—Nine consignment of Malayan tea were sold on the London market during September; three consignments were of upland tea, ranging from 1s. 0¼d.

to 1s. 0¾d. per lb. The lowland tea ranged from 11½ to 1s. per lb.

Average London prices per lb. during September for consignments of tea from other countries were as follows:—Ceylon 1s. 1.34d., Java 10.98d., Indian Northern 1s. 2.75d., Indian Southern 1s. 0.15d., Sumatra 10.07d.

The latest Colombo average prices available are quoted from the *Weekly Tea Market Report*, 29th September, 1936, of the Colombo Brokers' Association, and are as follows, in rupee cents per lb.:—High Grown Teas 80 cents, Medium Grown Teas 67 cents, Low Grown Teas 63 cents.

*Coffee.*—Sourabaya coffee weakened still further in Singapore during September, averaging $12.50 to $13.50 per picul as compared with $12.94 to $13.94 per picul in August. Palembang coffee averaged $6.70 to $8.05 per picul as against $6.80 to $7.70 in August.

## Spices.

*Arecanuts.*—The following are the averages of the ranges of prices per picul in Singapore during September: Splits $4.60 to $6.45; Red Whole $4.40 to $6.50; Sliced $8.90 to 11.20.

The Singapore Chamber of Commerce prices improved still further, average prices per picul being: Best $7.12, Medium $6.80, Mixed $6.05.

*Pepper.*—Nominal quotations were: Singapore Black $7.25, Singapore White $13, Muntok White $13.50 per picul.

*Nutmegs.*—Prices fell back again in Singapore during September. Average prices per picul for the month were: 110's $29.25, 80's $29.75, as compared with $29.40 and $29.60 respectively in August.

*Mace.*—Prices were higher in Singapore, but the market weakened in the second half of the month. Average prices per picul were: Siouw $92.50, Amboina $82.50, as compared with $90 and $75 respectively in August.

*Cloves.*—Nominal quotations were higher in the second half of the month, being $38 per picul for both Zanzibar and Amboina.

*Cardamoms.*—Green cardamoms were quoted during September in the Ceylon Chamber of Commerce reports from Rs. 1.40 to Rs. 1.80 per lb.

## Miscellaneous.

*Derris* (*Tuba Root*).—Continued lack of demand again contributed to a dull and uninteresting market throughout September. The average price per picul for roots sold on a basis of rotenone content remained unchanged at $48, while roots sold on a basis of ether extract fell to $30.

*Gambier.*—Block and No. 1 Cube were quoted throughout the month at $5 and $10 per picul respectively, as compared with August average prices of $4.80 and $9.80.

*Tapioca.*—Prices in Singapore continued unchanged with the exception of Seed Pearl which improved slightly at the close of the month. Closing prices per picul were: Flake, Fair $5.50, Seed Pearl $5.75, Medium Pearl $6.50.

*Sago.*—Prices improved in Singapore, averages for the month being: Pearl, Small Fair $4.38 and Flour, Sarawak Fair $2.86 per picul, as compared with $4.18 and $2.69 respectively in August.

*Tobacco.*—Prices in Kedah for locally grown tobacco were: 1st quality $85 to $90, 2nd quality $80, 3rd quality $64 per picul. Prices in other parts of the Peninsula were as follows: 1st quality $24 to $45, 2nd quality $19 to $32, 3rd quality $12 to $19.

The above prices are based on London and Singapore daily quotations for rubber; on the Singapore Chamber of Commerce Weekly Reports for the month and on other local sources of information. Palm oil reports are kindly supplied by Messrs. Guthrie & Co. Ltd., Kuala Lumpur; the Singapore prices for coffee and arecanuts by the Lianqui Trading Company of Singapore, and tuba prices by Messrs. Kohyei & Co., Singapore.

1 picul = 133⅓ lbs. The Dollar is fixed at two shillings and four pence.

*Note.*—The Department of Agriculture will be pleased to assist planters in finding a market for agricultural produce. Similar assistance is also offered by the Malayan Information Agency, 57, Charing Cross, London, S.W.1.

# GENERAL RICE SUMMARY*

**August, 1936.**

*Malaya.*—Imports of foreign rice during August were 67,825 tons, and exports 17,326 tons, net imports being 50,499 tons. Net imports for the eight months were 356,588 tons as compared with 306,216 tons in 1935.†

Of the imports during August, 49 per cent. were consigned to Singapore, 14 per cent. to Penang, 7 per cent. to Malacca, 23 per cent. to the Federated Malay States, and 7 per cent. to the Unfederated Malay States. The imports by country of origin were as follows:—Siam 69.9 per cent., Burma 28.9 per cent., French Indo-China 0.2 per cent., and other countries 1 per cent.

Of the August exports, 74 per cent. were consigned to the Netherlands Indies and 26 per cent. to other countries. The various kinds of rice exported were as follows (in tons, percentages in brackets): Siam 13,152 (75.9), Burma 2,618 (15.1), French Indo-China 403 (2.3), parboiled 1,098 (6.4), local production 55 (0.3).

*India and Burma.*—Foreign exports for the period January to July 1936 totalled 873,000 tons, as compared with 1,222,000 tons in 1935, a decrease of 28.6 per cent. Of these exports 3.9 per cent. were to the United Kingdom, 19.3 per cent. to the Continent of Europe, 27.7 per cent. to Ceylon, 19.9 per cent. to the Straits Settlements and the Far East, and 29.2 per cent. to other countries. The corresponding 1935 percentages were 4.6, 11.4, 21.3, 32.4, and 30.3.

*Siam.*—Exports of rice and rice products from Bangkok during June were 123,472 tons; the cumulative total for the half year was 815,489 tons as compared with 800,625 tons in 1935.

*Japan.*—Estimated supply and demand from 1st August to 31st October are as follows:—

| Supply | | Tons |
|---|---|---|
| Stocks ... ... ... | 2,864,000 | |
| Estimated imports ... ... | 463,000 | 3,327,000 |
| Demand: | | |
| Estimated exports ... ... | 14,000 | |
| Estimated consumption ... ... | 2,048,000 | 2,062,000 |
| Estimated surplus ... ... | | 1,265,000 |

According to the *Indian Trade Journal,* 13th August 1936, the area under the first crop in Formosa in 1936 is reported to be 745,000 acres, an increase of about 2 per cent. when compared with 1935. The yield is estimated to be

* Abridged from the Rice Summary for August, 1936, compiled by the Department of Statistics, Straits Settlements and Federated Malay States.

† It is to be understood throughout the summary that all comparisons and percentage increases or decreases are in relation to the corresponding period of 1935.

666,000 tons, which is expected to established a new record, showing an increase of 10 per cent. as compared with the first crop of 1935.

*French Indo-China.*—Entries of padi into Cholon during the first eight months of the year totalled 1,175,405 tons, a decrease of 9.2 per cent, when compared with the 1935 total of 1,293,996 tons. Exports of rice during the same period totalled 1,230,992 tons, as compared with 1,338,009 tons in 1935, a decrease of 8 per cent.

*The Netherlands Indies.*—The latest information available was published in the July Summary.

*Ceylon.*—Imports during the period January to August 1936 were 354,436 tons as compared with 345,422 tons in 1935, an increase of 2.6 per cent. Of these imports 13.4 per cent. were from British India, 62.6 per cent. from Burma, 0.5 per cent. from the Straits Settlements, and 23.5 per cent. from other countries. The 1935 corresponding percentages were: 12.8, 68.9, 1.0 and 17.3.

*Europe and America.*—Shipments to Europe from the East during the period 1st January to 14th August totalled 824,228 tons, as compared with 558,257 tons in 1935, an increase of 47.6 per cent. Of the 1936 shipments 31.5 per cent. were from Burma, nil from Japan, 59.9 per cent. from Saigon, 7.5 per cent. from Siam, and 1.1 per cent. from Bengal. The corresponding 1935 percentages were 55.1, 4.3, 34.4, 4.3 and 1.9.

Shipments for the Levant from 1st January to 30th July totalled 8,563 tons, as compared with 23,559 tons in 1935, a decrease of 63.7 per cent. Shipments for Cuba, West Indies and America from 1st January to 14th August were 169,657 tons, an increase of 1.8 per cent. over the 1935 shipments of 166,732 tons.

## MALAYAN AGRICULTURAL EXPORTS, AUGUST, 1936.

| PRODUCT. | Net Exports in Tons | | | | |
|---|---|---|---|---|---|
| | Year 1935 | Jan.-Aug. 1935 | Jan.-Aug. 1936 | August 1935 | August 1936 |
| Arecanuts ... | 21,885 | 14,281 | 20,357 | 363* | 3,023 |
| Coconuts, fresh † ... | 106,272† | 70,244† | 78,432† | 8,092† | 8,297† |
| Coconut oil ... | 35,911 | 21,260 | 30,653 | 3,280 | 4,123 |
| Copra ... | 111,752 | 70,013 | 44,617 | 8,461 | 12,290 |
| Gambier, all kinds ... | 2,837 | 1,769 | 1,403 | 164 | 115 |
| Oil cakes ... | 11,361 | 5,473 | 10,415 | 1,050 | 1,206 |
| Palm kernels ... | 3,892 | 2,392 | 2,743 | 510 | 378 |
| Palm oil ... | 24,996 | 13,840 | 17,945 | 1,764 | 4,529 |
| Pineapples canned ... | 73,923 | 51,950 | 60,568 | 5,911 | 5,674 |
| Rubber ¶ ... | 378,381¶ | 264,790¶ | 234,729¶ | 33,809¶ | 31,219¶ |
| Sago,—flour ... | 10,920 | 4,747 | 5,527 | 572* | 2,042 |
| ,, —pearl ... | 4,655 | 3,113 | 2,126 | 451 | 252 |
| ,, —raw ... | 7,735* | 4,565* | 4,775* | 389* | 648* |
| Tapioca,—flake ... | 1,953 | 1,281 | 1,130 | 145 | 128 |
| ,, —flour ... | 755* | 643* | 1,328* | 29* | 159* |
| ,, —pearl ... | 17,169 | 11,511 | 11,609 | 1,726 | 2,279 |
| Tuba root ... | 567 | 397 | 439 | 36 | 34 |

† hundreds in number. * net imports. ¶ production.

## MALAYAN PRODUCTION (IN TONS) OF PALM OIL AND KERNELS

(As declared by Estates)

| Month 1936 | Palm Oil | | Palm Kernels | |
|---|---|---|---|---|
| | F.M.S. | U.M.S. | F.M.S. | U.M.S |
| January ... | 1,395.4 | 326.5 | 258.6 | 37.2 |
| February ... | 1,531.9 | 372.4 | 244.2 | 54.6 |
| March ... | 1,878.4 | 534.5 | 302.9 | 88.0 |
| April ... | 1,410.6 | 446.8 | 250.0 | 80.0 |
| May ... | 1,346.1 | 644.8 | 238.1 | 114.6 |
| June ... | 1,557.4 | 658.3 | 245.5 | 100.9 |
| July ... | 2,270.5 | 975.7 | 349.1 | 147.6 |
| August ... | 2,963.2 | 1,029.0 | 419.2 | 163.0 |
| Total ... | 14,353.5 | 4,988.0 | 2,307.6 | 785.9 |
| Total January to August, 1935 ... | 10,773.0 | 3,915.2 | 1,619.8 | 574.7 |
| Total for year 1935 ... | 17,338.7 | 5,764.6 | 2,711.1 | 818.4 |

ACREAGES OF TAPPABLE RUBBER NOT TAPPED ON ESTATES OF 100 ACRES AND OVER, FOR THE MONTH ENDING 31ST AUGUST, 1936.

| STATE OR TERRITORY (1) | Acreage of Tappable Rubber end 1935 (2) | ESTATES WHICH HAVE ENTIRELY CEASED TAPPING | | ESTATES WHICH HAVE PARTLY CEASED TAPPING (*a*) | | AREA OF TAPPABLE RUBBER NEVER BEEN TAPPED | | Total (3) + (5) (9) | Percentage of (9) to (2) (10) |
|---|---|---|---|---|---|---|---|---|---|
| | | Acreage (3) | Percentage of (3) to (2) (4) | Acreage (5) | Percentage of (5) to (2) (6) | Acreage (7) | Percentage of (7) to (2) (8) | | |
| STRAITS SETTLEMENTS :— | | | | | | | | | |
| Province Wellesley ... ... | 44,526 | 400 | .9 | 16,246 | 36.5 | 504 | 1.1 | 16,646 | 37.4 |
| Malacca ... ... ... | 121,601 | 4,622 | 3.8 | 30,703 | 25.2 | 2,776 | 2.3 | 35,325 | 29.0 |
| Penang Island ... ... | 2,575 | 675 | 26.2 | 568 | 22.1 | 283 | 11.0 | 1,243 | 48.3 |
| Singapore Island ... ... | 34,525 | 3,929 | 11.4 | 9,373 | 27.1 | 334 | 1.0 | 13,302 | 38.5 |
| Total S.S. ... | 203,227 | 9,626 | 4.7 | 56,890 | 28.0 | 3,897 | 1.9 | 66,516 | 32.7 |
| FEDERATED MALAY STATES :— | | | | | | | | | |
| Perak ... ... ... | 294,988 | 11,684 | 4.0 | 69,809 | 23.6 | 14,838 | 5.0 | 81,493 | 27.6 |
| Selangor ... ... ... | 332,165 | 12,087 | 3.6 | 67,291 | 20.3 | 15,476 | 4.7 | 79,378 | 23.9 |
| Negri Sembilan ... ... | 258,304 | 12,955 | 5.0 | 53,408 | 20.7 | 17,147 | 6.6 | 66,363 | 25.7 |
| Pahang ... ... ... | 77,210 | 9,206 | 11.9 | 24,110 | 31.2 | 16,686 | 21.6 | 33,316 | 43.1 |
| Total F.M.S. ... | 962,667 | 45,932 | 4.8 | 214,618 | 22.3 | 64,147 | 6.7 | 260,550 | 27.1 |
| UNFEDERATED MALAY STATES :— | | | | | | | | | |
| Johore ... ... ... | 432,443 | 34,171 | 7.9 | 58,765 | 13.6 | 40,394 | 9.3 | 92,936 | 21.5 |
| Kedah ... ... ... | 199,607 | 22,696 | 11.4 | 25,497 | 12.8 | 16,182 | 8.1 | 48,193 | 24.2 |
| Kelantan ... ... ... | 30,474 | 403 | 1.3 | 10,032 | 32.9 | 4,704 | 15.4 | 10,435 | 34.2 |
| Trengganu (*b*) ... ... | 4,643 | Nil | Nil | Nil | Nil | 138 | 3.0 | Nil | Nil |
| Perlis (*c*) ... ... ... | 1,575 | Nil | Nil | 689 | 43.7 | 64 | 4.1 | 689 | 43.7 |
| Brunei ... ... ... | 6,010 | Nil | Nil | 1,662 | 27.7 | 913 | 15.2 | 1,662 | 27.7 |
| Total U.M.S. ... | 674,752 | 57,270 | 8.5 | 96,645 | 14.3 | 62,395 | 9.2 | 153,915 | 22.8 |
| TOTAL MALAYA ... | 1,840,646 | 112,828 | 6.1 | 368,153 | 20.0 | 130,439 | 7.1 | 480,981 | 26.1 |

*Notes* :—(*a*) Area out of tapping on Estates which have partly ceased tapping refers to areas definitely being rested and excludes areas on any tapping round.
(*b*) Registered Companies only.
(*c*) Rendered quarterly.

# MALAYAN RUBBER STATISTICS — TABLE I

## STOCKS, PRODUCTION, IMPORTS AND EXPORTS OF RUBBER, INCLUDING LATEX, CONCENTRATED LATEX AND REVERTEX, FOR THE MONTH OF AUGUST, 1936, IN DRY TONS.

| State or Territory | Stocks at beginning of month 1 | | | Production by Estates of 100 acres and over | | Production by Estates of less than 100 acres estimated 2 | | Imports | | | | Exports including re-exports | | | | Stocks at end of month | | | Consumption 3 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | during the month | | January to Aug. 1936 | | during the month | | January to Aug. 1936 | | | | | | |
| | Ports | Dealers | Estates of 100 acres and over | during the month | January to Aug. 1936 | during the month | January to Aug. 1936 | Foreign | From Malay States & Labuan | Foreign | From Malay States & Labuan | Foreign | Local | Foreign | Local | Ports | Dealers | Estates of 100 acres and over | during the month | January to Aug. 1936 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| MALAY STATES :— | | | | | | | | | | | | | | | | | | | | |
| Federated Malay States ... | ... | 7,701 | 11,289 | 11,276 | 80,015 | 4,664 | 41,164 | Nil | Nil | Nil | Nil | 11,628 | 4,202 | 90,661 | 29,882 | ... | 7,362 | 11,725 | 13 | 73 |
| Johore ... | ... | 2,594 | 4,235 | 4,280 | 32,449 | 3,554 | 24,354 | Nil | 110 | Nil | 635 | 2,486 | 5,638 | 17,824 | 38,819 | ... | 2,658 | 3,991 | ... | ... |
| Kedah ... | ... | 377 | 2,618 | 2,674 | 20,215 | 792 | 5,777 | Nil | Nil | Nil | Nil | 1,509 | 1,868 | 11,195 | 15,278 | ... | 308 | 2,776 | ... | ... |
| Perlis ... | ... | 13 | 18 | 11 | 85 | 15 | 155 | Nil | Nil | Nil | Nil | Nil | 29 | Nil | 236 | ... | 12 | 16 | ... | ... |
| Kelantan ... | ... | 307 | 329 | 324 | 2,282 | 583 | 4,638 | Nil | Nil | Nil | Nil | 182 | 765 | 1,141 | 5,734 | ... | 266 | 330 | ... | ... |
| Trengganu ... | ... | 55 | 50 | 283 | 1,798 | 141 | 899 | Nil | Nil | Nil | Nil | Nil | 424 | Nil | 2,697 | ... | 55 | 50 | ... | ... |
| Brunei ... | ... | 19 | 35 | 49 | 343 | 62 | 486 | ... | ... | ... | ... | ... | 109 | ... | 826 | ... | 11 | 45 | ... | ... |
| Total Malay States | ... | 11,066 | 18,574 | 18,897 | 137,187 | 9,811 | 77,473 | Nil | 110 | Nil | 635 | 15,805 | 13,035 | 120,821 | 93,472 | ... | 10,672 | 18,933 | 13 | 73 |
| S. SETTLEMENTS :— | | | | | | | | | | | | | | | | | | | | |
| Malacca ... | ... | 1,920 | 1,188 | 1,061 | 7,984 | 436 | 4,228 | Nil | | Nil | | 2,044 | | 18,778 | | ... | 2,474 | 1,116 | ... | ... |
| Province Wellesley ... | ... | 952 | 509 | 456 | 3,235 | 223 | 1,683 | Nil | | Nil | | 7,925 | | 58,525 | | ... | 933 | 522 | ... | ... |
| Penang ... | 1,330 | 5,021 | 9 | 13 | 127 | 69 | 633 | 2,469 | 11,807 | 20,622 | 89,973 | | Nil | | Nil | 1,914 | 3,801 | 8 | ... | ... |
| Singapore ... | 5,603 | 17,489 | 161 | 125 | 1,135 | 111 | 915 | 10,803 | | 96,930 | | 17,732 | | 145,453 | | 5,927 | 16,647 | 169 | 30 | 193 |
| Labuan ... | ... | 16 | Nil | Nil | Nil | 17 | 129 | 89 | | 567 | | Nil | | Nil | | ... | 22 | Nil | ... | ... |
| Total Straits Settlements ... | 6,933 | 25,398 | 1,867 | 1,655 | 12,481 | 856 | 7,588 | 13,361 | 11,807 | 118,119 | 89,973 | 27,701 | Nil | 222,756 | Nil | 7,841 | 23,877 | 1,815 | 30 | 193 |
| Total Malaya ... | 6,933 | 36,464 | 20,441 | 20,552 | 149,668 | 10,667 | 85,061 | 13,361 | 11,917 | 118,119 | 90,608 | 43,506 | 13,035 | 343,577 | 93,472 | 7,841 | 34,549 | 20,748 | 43 | 266 |

### TABLE II
### DEALERS' STOCKS, IN DRY TONS 3

| Class of Rubber | Federated Malay States | S'pore | Penang | Province We'sly D'dings M'cca. | Johore | Kedah |
|---|---|---|---|---|---|---|
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| DRY RUBBER | 6,319 | 15,782 | 3,449 | 2,950 | 2,006 | 162 |
| WET RUBBER | 1,043 | 865 | 352 | 490 | 652 | 146 |
| TOTAL ... | 7,362 | 16,647 | 3,801 | 3,440 | 2,658 | 303 |

### TABLE III
### FOREIGN EXPORTS

| PORTS | For month | January to Aug. 1936 |
|---|---|---|
| 29 | 30 | 31 |
| Singapore ... | 26,159 | 216,301 |
| Penang ... | 11,541 | 84,629 |
| Port Swettenham. | 5,529 | 39,671 |
| Malacca ... | 277 | 2,976 |
| MALAYA ... | 43,506 | 343,577 |

### TABLE IV
### DOMESTIC EXPORTS 4

| AREA | For month | January to Aug. 1936 |
|---|---|---|
| 32 | 33 | 34 |
| Malay States ... | 28,840 | 214,293 |
| Straits Settlements | 2,570 | 19,212 |
| MALAYA ... | 31,410 | 233,505 |

*Notes:*—

1. Stocks on estates of less than 100 acres and stocks in transit on rail, road or local steamer are not ascertained.
2. The production of estates of less than 100 acres is estimated from the formula: Production + Imports + Stocks at beginning of month = Exports + Stocks at end of month, + Consumption, *i.e.*, Column [7] = Columns [13] + [14] + [17] + [18] + [19] + [20] − [2] − [3] − [4] − [5] − [9] − [10]. For the Straits Settlements the production of estates of less than 100 acres is represented by sales or exports as shown by cess paid.
3. Dealers' stocks in the Federated Malay States are reduced to dry weights by the following fixed ratios: unsmoked sheet, 15% wet sheet, 25% scrap, lump, etc., 40%; stocks elsewhere are in dry weights as reported by the dealers themselves.
4. Column (33) and (34) represent exports of rubber subject to regulation which, for Singapore and Penang Islands are represented by sales or exports as shown by cess paid.
5. All statements are brought up to date monthly, and any inaccuracies that may be disclosed are corrected in the totals; the latest publication, therefore, is always the most reliable.
6. The above, with certain omissions, is the Report published by the Registrar-General of Statistics, S.S. and F.M.S., at Singapore on 23rd September, 1936.

# METEOROLOGICAL SUMMARY, MALAYA, AUGUST, 1936.

| Locality. | Air Temperature in degrees Fahrenheit | | | | | | | Earth Temperature | | Rainfall | | | | | | | | Bright Sunshine. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Means of | | | Absolute Extremes | | | | | | | | | Number of days. | | | | | | | |
| | A. Max. | B. Min. | Mean of A and B. | Highest Max. | Lowest Min. | Lowest Max. | Highest Min. | At 1 foot | At 4 feet | Total. | | Most in a day. Amt. | Precipitation .01 in or more | Precipitation, .04 in or more | Thunder-storm | Fog morning obs. | Gale force 8 or more | Total. | Daily Mean. | Per cent. |
| | °F | °F | °F | °F | °F | °F | °F | °F | °F | in. | mm. | in. | | | | | | Hrs. | Hrs. | |
| Railway Hill, Kuala Lumpur, Selangor ... | 91.2 | 71.6 | 81.4 | 98 | 69 | 86 | 74 | 83.7 | 84.6 | 4.06 | 103.1 | 1.53 | 14 | 12 | 1 | 1 | 1 | 188.30 | 6.07 | 49 |
| Bukit Jeram, Selangor ... | 88.3 | 72.3 | 80.3 | 92 | 69 | 83 | 75 | 84.0 | 86.2 | 5.66 | 143.8 | 2.16 | 10 | 8 | | | 2 | 217.10 | 7.00 | 57 |
| Sitiawan, Perak ... | 88.8 | 73.2 | 81.0 | 91 | 71 | 81 | 75 | 84.1 | 84.7 | 2.38 | 60.5 | 0.78 | 8 | 7 | | | | 220.25 | 7.10 | 58 |
| Temerloh, Pahang ... | 89.0 | 71.6 | 80.3 | 93 | 67 | 85 | 74 | 85.3 | 86.0 | 4.52 | 114.8 | 1.14 | 17 | 14 | 8 | 5 | | 194.10 | 6.26 | 51 |
| Kuala Lipis, Pahang ... | 89.6 | 71.0 | 80.3 | 93 | 69 | 84 | 74 | 83.9 | 84.9 | 3.88 | 98.6 | 1.37 | 14 | 10 | 6 | 18 | | 178.95 | 5.77 | 47 |
| Kuala Pahang, Pahang ... | 87.0 | 73.8 | 80.4 | 91 | 72 | 84 | 77 | 85.4 | 86.6 | 6.24 | 158.5 | 2.44 | 11 | 10 | | | 2 | 21..90 | 6.83 | 56 |
| Kallang Aerodrome, S'pore ... | 85.5 | 75.8 | 80.7 | 89 | 73 | 80 | 81 | 82.6 | 84.1 | 4.48 | 113.8 | 1.01 | 23 | 17 | 1 | | | 177.60 | 5.73 | 47 |
| Butterworth, Province Wellesley ... | 87.0 | 73.9 | 80.5 | 90 | 72 | 79 | 76 | 84.4 | 85.3 | 7.95 | 201.9 | 1.38 | 19 | 16 | 1 | | 1 | 190.60 | 6.15 | 50 |
| Bayan Lepas Aerodrome Penang ... | 86.7 | 74.1 | 80.4 | 89 | 72 | 81 | 76 | 83.5 | 84.3 | 10.42 | 264.7 | 2.63 | 20 | 16 | 1 | 1 | | 178.60 | 5.76 | 47 |
| Bukit China, Malacca ... | 84.7 | 73.2 | 78.9 | 87 | 70 | 82 | 76 | 82.5 | 83.6 | 13.96 | 354.6 | 2.75 | 21 | 17 | 4 | | 2 | 180.40 | 5.82 | 48 |
| Kluang, Johore ... | 87.8 | 70.9 | 79.3 | 91 | 69 | 84 | 74 | 81.6 | 82.4 | 6.71 | 170.4 | 1.20 | 17 | 15 | 4 | 3 | 1 | 164.75 | 5.31 | 43 |
| Bukit Lalang, Mersing, Johore | 86.6 | 71.5 | 79.1 | 89 | 69 | 83 | 74 | 81.8 | 81.9 | 7.47 | 189.7 | 1.40 | 18 | 16 | 2 | 1 | 4 | 173.70 | 5.60 | 46 |
| Alor Star, Kedah ... | 87.2 | 74.1 | 80.7 | 90 | 72 | 82 | 77 | 85.5 | 86.2 | 11.01 | 279.7 | 1.98 | 19 | 17 | | | | 168.05 | 5.60 | 45 |
| Kota Bahru, Kelantan ... | 89.2 | 73.0 | 81.1 | 92 | 71 | 85 | 76 | 84.3 | 84.8 | 8.30 | 210.8 | 1.36 | 22 | 21 | 7 | 1 | 6 | 209.60 | 6.76 | 55 |
| Kuala Trengganu, Trengganu | 87.9 | 72.0 | 79.9 | 90 | 70 | 84 | 74 | 83.1 | 84.6 | 10.09 | 256.3 | 1.64 | 19 | 15 | 6 | 1 | 2 | 199.80 | 6.45 | 52 |
| HILL STATIONS. | | | | | | | | | | | | | | | | | | | | |
| Fraser's Hill, Pahang 4268 ft. | 74.2 | 62.1 | 68.1 | 79 | 59 | 70 | 64 | 71.3 | 72.3 | 10.39 | 263.9 | 1.35 | 19 | 18 | | 10 | 1 | 164.85 | 5.32 | 44 |
| Cameron Highlands, Tanah Rata, Pahang 4750 ft. ... | 72.2 | 56.9 | 64.5 | 77 | 50 | 68 | 62 | 70.4 | 70.1 | 7.68 | 195.1 | 0.99 | 22 | 20 | 2 | 1 | 1 | 151.90 | 4.90 | 40 |
| Cameron Highlands, Rhododendron Hill, Pahang 5120 ft. ... | 71.4 | 59.4 | 65.4 | 76 | 58 | 66 | 61 | | | 7.41 | 188.2 | 1.08 | 21 | 19 | 2 | 1 | 1 | 157.70 | 5.09 | 41 |

Compiled from Returns supplied by the Meteorological Branch, Malaya